OPERATION AND
SERVICE MANUAL

198 4540K18-300

TOXIC VAPOR MONITOR
TVM-1

This publication provides Operation, Installation, Maintenance, Troubleshooting, and Parts Replacement instructions for the Toxic Vapor Monitor

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

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WARRANTY

General Electric Company warrants to the purchaser that the equipment to be delivered hereunder with the exception of expendable items (sensors, purifiers, filters, fuses, lamps) will be free from defects in material, workmanship and title and will be of the kind and quality designated or described in the contract.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, IMPLIED, OR STATUTORY, AND NO WARRANTY OF MECHANTABILITY OR OF FITNESS FOR PURPOSE SHALL APPLY.

If it appears within one year from date of shipment by the Company that the equipment delivered hereunder does not meet the warranties specified above and the purchaser notifies the Company promptly in writing, the Company shall thereupon correct any defect, including non-conformance with the specifications, at its option, either by repairing any defective part or parts or by making available at the Company's plant, a repaired or replacement part. The liability of the Company to the Purchaser (except as to title) arising out of the supplying of said equipment, or its use, whether on warranty, contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment as herein provided and upon expiration of said one year, all liability shall terminate. The foregoing shall constitute the sole remedy of the Purchaser and the sole liability of the Company.

Any equipment supplied which is not manufactured by General Electric Company and which is not an integral part of the standard General Electric Company monitor will be warranted only to the extent of the warranty of the manufacturer of that equipment.

NOTE: Use of the TVM-1 Monitor in a corrosive atmosphere will void the warranty.

FOREWORD

WARNING: MONITOR MUST BE INSTALLED IN A WELL VENTILATED AREA TO ENSURE DISPERSION OF SAMPLED GASES AND PREVENT ACCUMULATION OF POTENTIALLY TOXIC CONCENTRATIONS. MODEL 50-423103FAFF2 AND LATER MONITORS HAVE AN EXHAUST PORT WHICH ALLOWS UP TO 100 FEET (30 METERS) OF MONITOR SAMPLE LINE TO BE CONNECTED TO CARRY AWAY EXHAUST GASES TO THE OUTSIDE OR TO AN EXHAUST HOOD.

For prompt and complete repair service by factory-trained and qualified personnel, please contact:

Product Service
General Electric Company
Instrument Products Operation
40 Federal Street
Lynn, Massachusetts 01910
Telephone: (617)594-7005

Loaner units, if required, will be available free of charge during warranty repair.

In addition to this publication 4540K18-300, new users of toxic vapor detection equipment will find more information and data pertinent to leak detector applications and calibrated leaks in the Leak Detector Manual (Publication ID-4816) issued by the General Electric Company. Copies of either manual can be ordered from the Instrument Products Operation, A&SP, General Electric Company, 40 Federal Street, Lynn, MA 01910. Telephone: (617)594-7000.

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PART 1

OPERATING INSTRUCTIONS

SECTION I

RECEIVING AND HANDLING

1.1 INTRODUCTION

Part 1 of this manual has been prepared as an aid to operating personnel in receiving, handling, and operating the Toxic Vapor Monitor TVM-1. After the Toxic Vapor Monitor has been installed and calibrated in accordance with Part 2, Section IV of this manual, the following instructions can be utilized by operating personnel in their daily routine of monitor operation. Figure 1-1 in Part 2 of this manual illustrates the Toxic Vapor Monitor TVM-1 and its accessories.

1.2 RECEIVING

Upon receipt of the monitor, examine it for any damage which may have occurred in transit. Immediate examination is especially important if rough handling is evident. If damage is found, a claim should be filed immediately with the transportation company. The shipping container should be retained by the user to assist in evaluating the damage to the device or for storage and reshipment.

Shipping carton for external calibration model contents:

1. Monitor
2. 10-foot length of gas tubing with one female and two male connectors
3. Instruction book

Shipping carton for internal calibration model contents:

1. Monitor
2. Instruction book

The Monitor is a rugged electromechanical instrument weighing approximately 23 pounds (10 kilograms). Observe normal precautions for electromechanical equipment during handling.

1.3 STORAGE

If the equipment is to be stored prior to use, repack it in its original packing material and container, if possible. Store it in a dry area free of corrosive vapors and extremes in temperature.

1.4 SHIPMENT

To provide adequate protection for the equipment when shipping it from one location to another, pack it in the original material. If this packing is not available, "float" the equipment in a box large enough to permit four or five inches of wedging with shredded paper, rubberized hair or equivalent. Use a method of shipment which will ensure that normal precautions for electromechanical equipment are observed.

SECTION II

OPERATING INSTRUCTIONS

After completion of the installation and calibration procedure, noting the [WARNINGS] in regard to power and exhaust gases described in Part 2, Section IV of this manual, the monitor is ready for operation.

2.1 WARM-UP AND CHECKOUT

Turn the RANGE switch to the desired range setting in order to turn on monitor power and set the operating range. Note that the POWER lamp lights. If monitor has been calibrated for log scale readings, the LOG SCALE lamp will also light. For direct readings by log scale (except 3 X 10^X), set RANGE switch to one of the desired ranges 1 X 10^X and apply the scale factor. (Scale factor = Range setting divided by 100.)

2.1.1 Warm-Up

Allow a minimum of ten minutes for warm-up. The monitor will automatically initiate a calibration cycle followed by sample cycles. During this warm-up interval alarm lights may flash until the unit is stabilized.

NOTE: UNDER NORMAL OPERATING CONDITIONS THE MONITOR IS READY FOR USE AFTER A TEN-MINUTE WARM-UP. HOWEVER, AFTER TWENTY-FOUR HOURS OF SHUTDOWN, IT IS RECOMMENDED THAT THE WARM-UP BE INCREASED TO TWENTY MINUTES AND THAT NO ADJUSTMENTS BE ATTEMPTED UNTIL WARM-UP PERIOD IS COMPLETE.

2.1.2 SENSOR FLOWmeter and SAMPLE FLOWmeter Setting

Check SAMPLE FLOWmeter and SENSOR FLOWmeter for approximately midscale indications.

NOTE: THE SAMPLE FLOW, IN MONITORING INSTALLATION, MAY BE MORE OR LESS THAN MIDSCALE DEPENDING ON THE LENGTH OF SAMPLE TUBING, HOWEVER, THE FLOWMETER SHOULD INDICATE SOME FLOW. THE LOWER FLOW RATES RESULT IN A GREATER LAG TIME IN INDICATING A GAS CONCENTRATION CHANGE THAT HAS OCCURRED AT ACTUAL SAMPLE ENTRY POINT. IF FLOWS ARE NOT CORRECT, REFER TO FIGURE 8-6 IN PART 2 OF THIS MANUAL AND ADJUST FLOWMETER NEEDLE VALVES FOR A READING ON THE FLOWMETERS.

2.1.3 MANUAL CALIBRATE Check

1. Press MANUAL CALIBRATE pushbutton and release.

2. Observe following:

   a. CALIBRATE lamp lights for a full cycle until SAMPLE lamp lights a minimum of 2 minutes after MANUAL CALIBRATE pushbutton is released.

b. PPM meter will pass through following indication phases while CALIBRATE lamp is lit.

For Catalog No. 50-423103FAFF1 and 50-423103FAFF2:

(1) First phase, approximately 65 seconds after CALIBRATE lamp lights, will be a reading of greater than 9 on top linear 0-10 scale. (This is a calibration marker for recorders.)

(2) Second phase, approximately 30 seconds later, meter will indicate a calibration sample reading anywhere up to and including full scale.

(3) Third phase, approximately 30 seconds later, will indicate a calibration level corresponding to the AUTO CAL control position as set during the instrument's initial calibration. This reading will remain displayed until SAMPLE lamp extinguishes at end of first sample cycle.

For Catalog No. 50-423103FAFF3:

When set up for single point monitoring, operates the same as for Catalog No. 50-423103FAFF1 or 50-423103FAFF2. When set up for use with a multipoint scanner the first phase is omitted, and the second phase is entered approximately 90 seconds after pressing the MANUAL CALIBRATE pushbutton.

c. The calibration reading should agree with concentration of standard gas. If it does not, AUTO CAL control setting should be checked.

d. If CALIBRATE ALARM lamp is flashing, check and adjust AUTO GAIN control.

2.2 NORMAL OPERATION

One of the features of the monitor is that it is an automatically self-calibrating instrument once it has been initially calibrated.

When the monitor is operating, it will automatically sample at a time interval set during calibration of between 2 and 12 minutes. The PPM meter may be read anytime that the SAMPLE or CALIBRATE lamps are not lit. The audio and visual alarms will indicate when sample measurements are above preset levels and will continue to operate until a measurement is indicated below this preset level.

2.3 MANUAL OPERATION

The monitor may also be used to manually obtain a sample measurement of a gas by pressing the MANUAL SAMPLE pushbutton or to manually calibrate by pressing the MANUAL CALIBRATE pushbutton when the SAMPLE, CALIBRATE, CALIBRATE ALARM, or NOT READY lamps are not lit.

2.4 PORTABLE OPERATION

If a survey probe is being used, press and release the sample pushbutton on the probe handle to initiate a measurement. Observe that the SAMPLE lamp on the monitor is lit. When the lamp extinguishes, read the PPM on the meter. Survey probe sample alarm lamp on the probe and SAMPLE ALARM lamp on the front panel of the monitor will light when the PPM exceeds the video alarm setting.

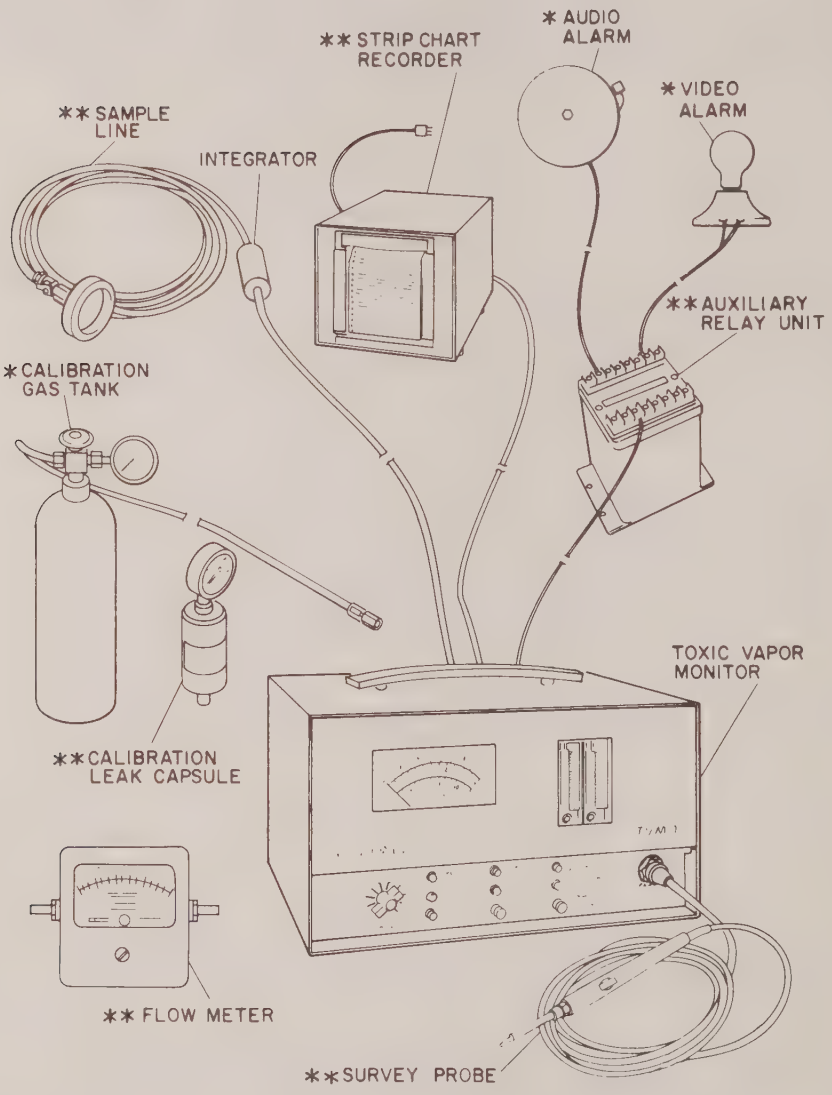


Figure 1-1. Toxic Vapor Monitor TVM-1 and Accessories

PART 2

SERVICE INSTRUCTIONS

SECTION I

INTRODUCTION

Part 2 of this manual has been prepared as an aid in performing maintenance and repair operations on the Toxic Vapor Monitor TVM-1 that can be carried out in the field. It provides a description of the monitor and accessories, a general theory of how the monitor operates, and instructions for isolating and correcting basic malfunctions. For service beyond the capability of the user, refer to the FOREWORD of this publication.

The Toxic Vapor Monitor TVM-1 together with its accessories (see Figure 1-1), provides a means of detecting halogenated gases. The sensitivity of the monitor to the specific gas being sampled depends upon the molecular composition of that gas. Thus, the monitor is calibrated by using an internal or external supply of reference gas (R-12 calibrating gas) of known concentration. During operation, the monitor compares the gas being sampled with the calibrating gas and provides an indication of the sample gas concentration.

Long experience with this particular monitor sensor unit in refrigerant leak detection has led to the preparation of Table 4-2 which presents the approximate relative sensitivities of many halogen gases with respect to R-12 refrigerant. Some of these values are based upon laboratory measurements while others are estimates based upon the comparison of chemical formulas. This relative sensitivity information is presented for guidance only. The user should evaluate the monitor for each specific application.

The Toxic Vapor Monitor continually monitors, or manually surveys, a selected area for toxic vapors or gas concentrations and displays the measurements in volume parts per million (PPM) on a front panel meter. Air samples may be taken manually or automatically at preset intervals from 2 to 12 minutes around-the-clock. The sample air is processed through a DYNA-LOOP™ system. The DYNA-LOOP is an electro-pneumatic measurement system combining a synchronous speed motor, a dual section air pump, replacement filters, electronically controlled valving, and a long life sensor that provides high accuracy. When the gas concentration exceeds set levels, audio and/or visual alarms are given.

One of the major features of the monitor is its DYNA-LOOP system. By sampling for 30 seconds in eight intervals of 2 to 12 minutes and purifying the gas remaining in the DYNA-LOOP after each sample, sensor life is prolonged and continued high grade sample readings are maintained.

Signals for remote recording of measured concentrations, calibration levels, and output signals for use with remote alarms, are provided through a connector at the rear of the unit. Power for operating a remote relay acces-

sory for alarm devices is also provided through this connector. The monitor can be used with up to 1000 feet of sampling line for continuous automatic area monitoring. An optional 15 foot long survey probe, which has a built in sampling switch and a video sample alarm indicator, permits convenient use of the monitor as a manually operated survey or leak detection instrument.

Sampling and calibration cycles are automatically controlled by solid state electronics with the monitor periodically calibrating itself to an external calibration halogen gas supply or to an internal reference calibration leak capsule. This automatic calibration feature allows long periods of unattended operation.

Three models of the TVM-1 monitor are described herein. Earlier models (50-423103FAFF1 and 50-423103FAFF2) provide for single point monitoring or manual survey applications. Model 50-423103FAFF2 provides an exhaust port feature. Model 50-423103FAFF3 has the additional capability of interfacing with a multipoint scanner. Instructions for multipoint operation are included in the scanner publications.

SECTION II

SPECIFICATIONS

POWER:	117 volts, nominal (110 to 127 volts) 60 Hz, 140 watts max or 234 volts, nominal (220 to 254 volts) 50 Hz, 140 watts max
RANGE:	0.1 to 10,000 PPM
SAMPLE DISTANCE:	Up to 1000 feet (300 meters)
SAMPLE FREQUENCY:	Variable 2 to 12 minutes
READOUT:	Direct in PPM from front panel meter Output for analog recorder: Signal proportional to PPM 0-10 VDC meter reading with provision for identifying auto-calibrate cycle
ALARMS:	Independently set audible and visual
CALIBRATION:	Automatic self calibrating internally with R-12 gas or externally with user supplied reference gas
ACCURACY:	±10% full scale for R-12 gas (See Table 4-2 for approximate sensitivities of other toxic vapors relative to R-12.)
AMBIENT TEMPERATURE OPERATING RANGE:	32^{o}F to 131^{o}F (0^{o} to 55^{o}C)
SIZE:	11-3/4 in. wide by 6-1/2 in. high by 12-3/4 in. deep (30 cm wide by 17 cm high by 32 cm deep)
WEIGHT:	23 pounds (10 kilograms) (approximate)
CATALOG NUMBER:*	50-423103FAFF1 - Single point monitor 50-423103FAFF2 - Single point monitor with exhaust port 50-423103FAFF3 - Single point monitor with provision for multipoint operation
ACCESSORIES:**	Calibration leak capsule Sample line Survey probe Auxiliary relay unit Integrator Strip chart recorder Flowmeter

*Catalog numbers are for monitors that use an external reference gas for calibration. Monitors that use an internal calibration leak capsule will have an additional 3 letter suffix added to their catalog number depending on size of calibration leak capsule.

**See Section III for description of monitor accessories.

MONITOR CONSTRUCTION MATERIALS AND FINISHES:***	Felted Refractory Fiber Insulation
	Neoprene Sheet Rubber
	Molded Neoprene Rubber
	Molded Butyl Rubber
	Fluorocarbon Rubber Gasket
	Low Moisture Absorption Silicone Rubber
	Electrical Grade Polytetrafluoroethylene (PTFE) (Teflon)
	Heat Stabilized Nylon
	Polyallomer Tubing (Imperial - Eastman)
	Polyester Felt (High Density)
	Silicone Rubber Tubing
	Silicone Rubber Parts
	High Carbon Steel Wire
	Cold Finished Chromium-Nickel Steel (Stainless) Type 303
	Annealed and Pickled Type 304 Chromium Steel Seamless Tubing
	Brass Half Hard (Standard Free Turning Brass)
	Solution Heat Treated Aluminum Alloy Type 2011
	Solution Heat Treated Aluminum Copper Alloy Type 2024
	Artificially Aged Aluminum-Magnesium Silicone Alloy
	Activated Charcoal
	Anodized Aluminum Finish 5% Dicromatic Seal
	Anodized Aluminum Finish 5% Water Seal
	Anodized Aluminum Finish 5% Black Dyed
	Chromate Treatment for Cadmium and Zinc (Yellow Iridescent)
	Glass Fiber Type A-E
	Monel
	0.0002" Max thickness of Bright Zinc Electroplate
	Semi-Bright Nickel Electro Plate
	0.0002" Max thickness of Bright Nickel Electroplate
	Passivation (Stainless Steel)

*** Construction materials and finishes are listed to assist in user determination of the corrosive effect that various gases may have on the monitor.

SECTION III

DESCRIPTION

3.1 TVM-1 TOXIC VAPOR MONITOR

The TVM-1 Monitor can be used either as a portable unit with a hand-held probe or installed as a permanent unit with a sample line to monitor certain halogen-compound gases in a remote area. The monitor consists of a main manifold and a sample manifold together with needle adjusting valves and electric solenoid valves to control the intake and measurement of the sample gas. Also part of the monitor are three printed circuit boards, a pump, fan, transformer, loudspeaker, filters, a sensor, and various controls and indicators.

Operating controls and indicators for the monitor are shown in Figures 3-1 and 3-2 and identified in Table 3-1. Major components of the monitor also shown in Figures 3-1 and 3-2 are identified in Table 3-2.

Calibration controls are shown in Figure 4-3 and identified in Table 4-1.

Table 3-1. Controls and Indicators

Figure Item No.	Control or Indicator	Function
Figure 3-1		
1	PPM meter	Indicates magnitude of halogen concentration in PPM with two scale arcs, a black linear arc marked 0-10, 0-3 and a red logarithmic arc marked 0.1 to 100.
2	RANGE switch	Controls instrument power and selection of any one of nine different meter ranges.
3	LOG SCALE lamp	Lights when logarithmic display has been selected.
4	NOT READY lamp	Lights when monitor is not ready for manual sample or manual calibration.
5	POWER lamp	Lights when RANGE switch is not in OFF position.
6	SAMPLE ALARM lamp	Flashes when measured PPM level exceeds preset alarm point.
7	SAMPLE lamp	Lights when monitor is in sample mode of operation.

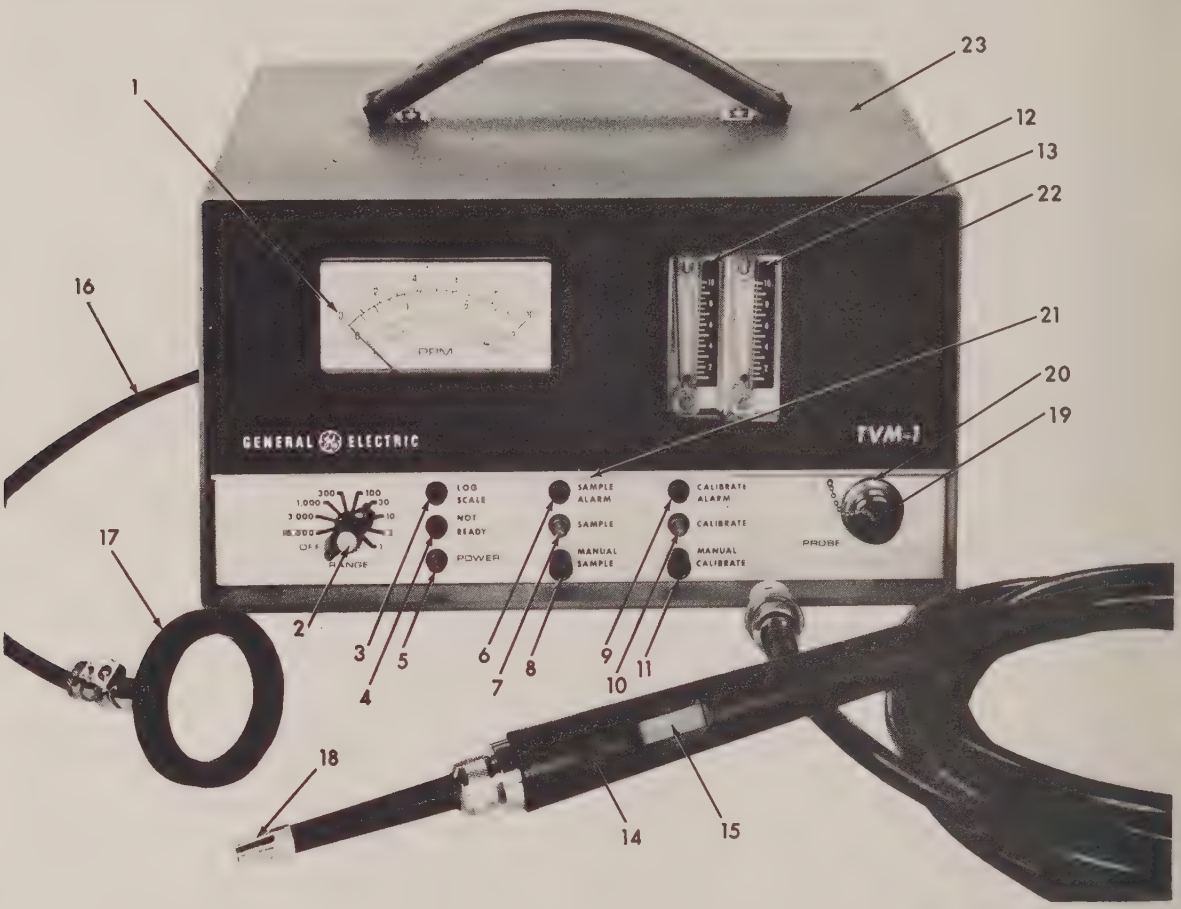


Figure 3-1. Controls and Indicators

Table 3-1. Controls and Indicators (Cont.)

Figure Item No.	Control or Indicator	Function
8	MANUAL SAMPLE pushbutton	Manually places monitor into sample mode of operation.
9	CALIBRATE ALARM lamp	Flashes when monitor is out of auto-calibration range.
10	CALIBRATE lamp	Lights when monitor is in calibration mode.
11	MANUAL CALIBRATE pushbutton	Manually places monitor into calibration mode of operation.
12	SAMPLE flowmeter	Indicates flow of gas through control loop portion of monitor gas flow system.

Table 3-1. Controls and Indicators (Cont.)

Figure Item No.	Control or Indicator	Function
13	SENSOR flowmeter	Indicates flow of gas through (sensor) DYNA-LOOP portion of monitor gas flow system.
14	Survey probe sample alarm light	Flashes when measured PPM level exceeds preset alarm point.
15	Survey probe manual sample pushbutton	Manually places monitor into sample mode of operation.
Figure 3-2		
17	Flow needle valve	Adjusts zero gas flow.

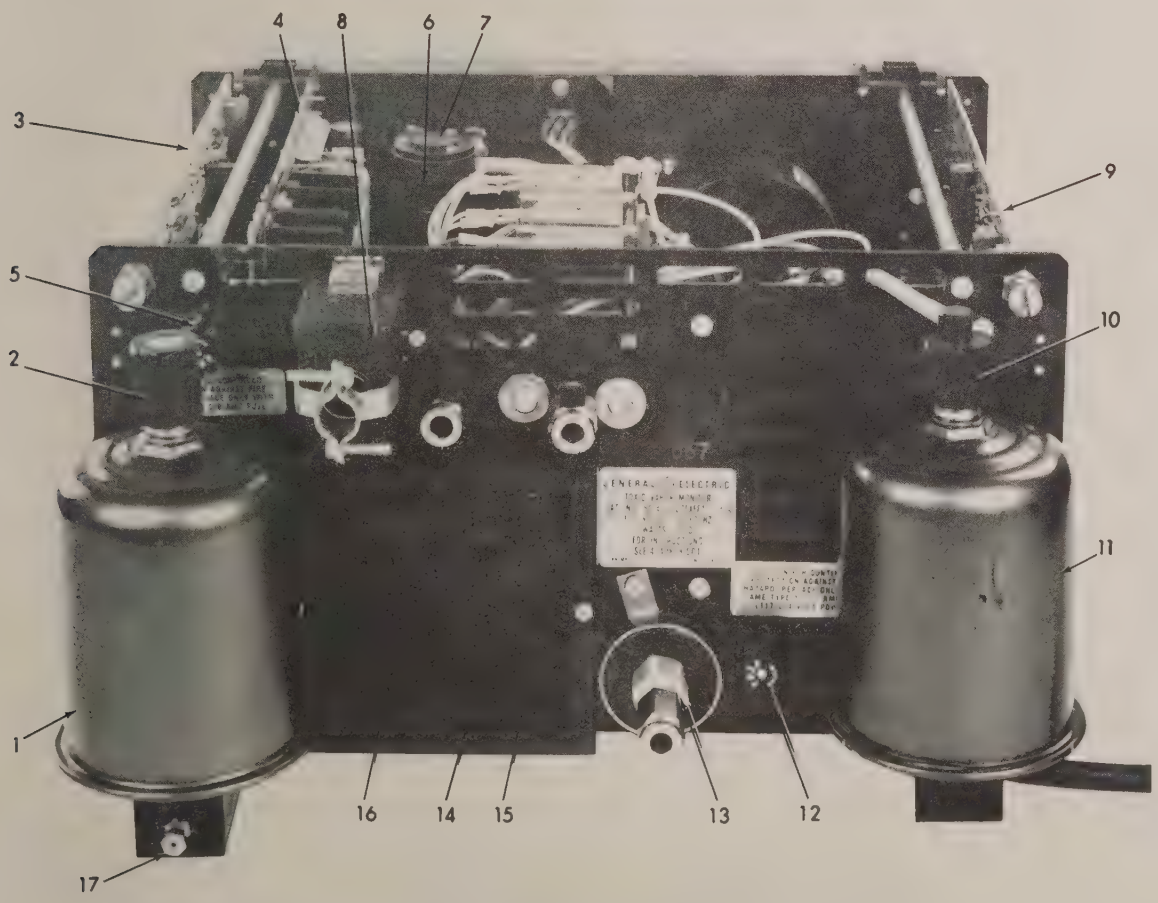


Figure 3-2. Major Components

Table 3-2. Major Components

Figure Item No.	Component	Function
Figure 3-1		
16	Sample line	Allows gas sampling at remote locations.
17	Sample line filter	Inhibits entry of water, dust, and dirt particles into sample stream.
18	Survey probe	Provides survey or leak detecting capability.
19	Survey probe connector cover	Seals gas inlet of survey probe connector.
20	Survey probe connector	Provides gas and electrical connections for survey probe.
21	Locking screw	Secures hinged front cover.
22	Hinged front cover	Protects calibration controls from inadvertent movement.
23	Case	Encloses and protects monitor.
Figure 3-2		
1	Zero gas purifier	Cleans air for system zero gas check.
2	Check valve	Controls and filters gas in zero gas input line.
3	Alarm and logic printed circuit board	Provides timing, alarm, and logic functions.
4	Power supply printed circuit board	Supplies dc power for electronics and sensors.
5	Fuse holder	Mounts 3/8 amp fuse for 12-18 Vdc power supply.
6	Sensor	Senses halogen vapors.
7	Sensor filter	Keeps DYNA-LOOP free of particulates.

Table 3-2. Major Components (Cont.)

Figure Item No.	Component	Function
8	Output connector	Provides 12-18 Vdc at 10 mA power for remote alarms and a PPM output signal voltage of 0-10 Vdc 1 mA for recorder.
9	Amplifier printed circuit board	Amplifies sensor signals and provides peak read, hold, and auto gain functions.
10	Check valve assembly	Controls air in DYNA-LOOP gas flow system.
11	DYNA-LOOP gas purifier	Filters gases in DYNA-LOOP gas flow system.
12	Fuse holder	Holds 1-1/2 amp fuse for line voltage input power.
13	External calibrating gas connector	Allows quick connector for external calibrating gas.
14	Filter assembly	Filters dirt and dust from cooling fan air intake.
15	Monitor sample line connector	Allows quick connection for monitor sample line.
16	*Exhaust port	Provides for exhaust of sample gas.

*Models 50-423103FAFF2 and after.

3.2 ACCESSORIES

3.2.1 Calibration Leak Capsule

Calibration leak capsules provide accurate leakage rates of R-12 gas for internal calibration of the monitor. They have a pyrex glass capillary, mounted on a capsule of gas, with a gage to indicate a LEAK FACTOR (multiplier). When the pointer is at the red line, the standard leak rate and nominal PPM as stamped on the capsule nameplate applies. The other gage marks indicate multipliers of the standard leak rate or nominal PPM value. The PPM rating applies only when the monitor zero gas flow rate has been set to 10 cc/sec as described in paragraph 6.4.5.

For additional information, refer to Instruction Sheet 198 4540K51-003. Leak capsules are available in the following sizes:

Leak Size cc/sec	Nominal Concentration Range in PPM (R-12)	Catalog Number
3×10^{-3}	150-1500	50 - 420702AAAW1AAA
10×10^{-4}	50-500	50 - 420702AAAU1AAA
3×10^{-4}	15-150	50 - 420702AAAT1AAA
10×10^{-5}	5-50	50 - 420702AAAS1AAA
3×10^{-5}	1.5-15	50 - 420702AAAR1AAA
10×10^{-6}	0.5-5	50 - 420702AAAP1AAA
3×10^{-6}	0.15-1.5	50 - 420702AAAN1AAA

Figure 3-3. Calibration Leak Capsule

3.2.2 Sample Line

Standard Impolene sample lines with quick-connect fittings at each end and an input filter to protect the monitor from dirt may be obtained in the following lengths:

Length (feet/meters)	Drawing Number
50/15	8690K18G1
100/30	8690K18G2
500/150	8690K18G4

Figure 3-4. Sample Line

3.2.3 Survey Probe

The survey probe (Drawing Number 5875K10G2) is designed to withstand continuous use in commercial environments. It has a built-in switch to permit manual sampling and a light emitting diode as an alarm signal for the presence of a toxic vapor. A 15 foot (4.6 meter) cable connects the probe to the monitor.

Figure 3-5. Survey Probe

3.2.4 Auxiliary Relay Unit

The auxiliary relay unit (Drawing Number 6124K10G1) provides four relays (in one housing) with normally open/closed contacts to operate remote and video alarms. The relay contacts are rated for a 5 amp, 120 volt ac noninductive load. The user must provide the connecting cable between the monitor and the relay unit. (See Figure 4-1 or 4-2.) The connector for the cable is supplied with the monitor.

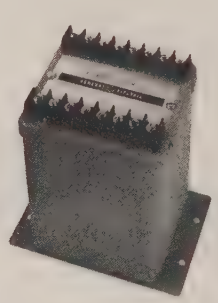


Figure 3-6. Auxiliary Relay Unit

3.2.5 Integrator

The integrator may be installed in the sample line to provide average readings in a monitored area by smoothing peaks in a gas concentration. It can be obtained with the following ratings:

Integration Range (min)	Drawing Number
3	4609K41G1
5	4609K41G2
10	4609K41G3

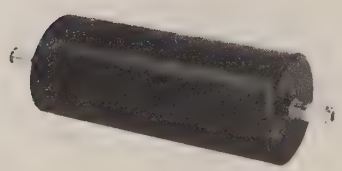


Figure 3-7. Integrator

3.2.6. Strip Chart Recorder

The strip chart recorder (Drawing Number 1269K17G1) provides both a visual and a permanent indication of the monitored gas concentrations. See instructions provided with recorder. The user must provide the connecting cable between the monitor and the strip chart recorder. (See Figure 4-1 or 4-2.) The connector for the cable is supplied with the monitor.

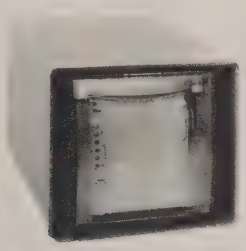


Figure 3-8. Strip Chart Recorder

3.2.7 Flowmeter

The flowmeter (Drawing Number 5225K43) is used in installation and calibration of the monitor when an external tank of gas is the calibration standard.

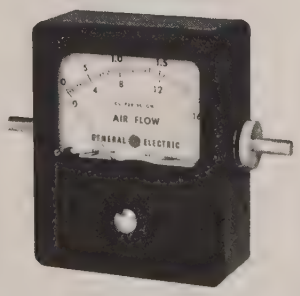


Figure 3-9. Flowmeter

SECTION IV

INSTALLATION AND CALIBRATION

4.1 INSTALLATION

WARNING: MONITOR MUST BE INSTALLED IN A WELL VENTILATED AREA TO ENSURE DISPERSION OF SAMPLED GASES AND PREVENT ACCUMULATION OF POTENTIALLY TOXIC CONCENTRATIONS. MODEL 50-423103FAFF2 AND LATER MONITORS HAVE AN EXHAUST PORT WHICH ALLOWS UP TO 100 FEET (30 METERS) OF MONITOR SAMPLE LINE TO BE CONNECTED TO CARRY AWAY EXHAUST GASES.

Installation and calibration procedures should be performed only by qualified personnel. After unpacking the monitor and checking for physical damage, perform the following initial steps:

NOTE: THE MONITOR IS SHIPPED FROM THE FACTORY READY FOR 117 VOLT, 60 HERTZ OPERATION.

1. Connect power cord to power source.

WARNING: IF A POWER OUTLET WITH A GROUND-LINE CONNECTION IS NOT AVAILABLE AND AN ADAPTER PLUG IS USED, MAKE SURE THAT PIG-TAIL GROUNDING LEAD IS CONNECTED TO A GOOD EARTH GROUND, SUCH AS A WATER PIPE. FAILURE TO CONNECT GROUND MAY RESULT IN ELECTRIC SHOCK CAUSING SERIOUS OR FATAL INJURY.

2. Connect either a survey probe to connector (20, Figure 3-1) on front of monitor or a sample line to connector (15, Figure 3-2) on rear of monitor.

CAUTION: NEVER PLACE SURVEY PROBE TIP DELIBERATELY IN A STREAM OF HALOGEN GAS (SUCH AS OPEN-VALVE STREAM OF GAS FROM REFRIGERANT CYLINDER) AS THIS WILL SHORTEN SENSOR LIFE CONSIDERABLY. NEVER ALLOW LIQUID TO ENTER SURVEY PROBE OR SAMPLE LINE.

* * *

CAUTION: WHEN SAMPLE LINE IS USED, SURVEY PROBE MUST BE DISCONNECTED AND CAP PLACED TIGHTLY ON CONNECTOR TO STOP AIR FLOW AND KEEP LINES CLEAN. WHEN SURVEY PROBE IS USED, SAMPLE LINE SHOULD BE DISCONNECTED. SAMPLE LINE CONNECTION IS A SELF-SEALING QUICK DISCONNECT, THEREFORE, NO CAP IS NEEDED. A SAMPLE LINE INPUT FILTER SHOULD ALWAYS BE USED.

4.1.1 Installing Auxiliary Relay Unit/Strip Chart Recorder

Figures 4-1 and 4-2 show the electrical connections that can be made to provide alarm indications at remote locations or to connect a strip chart recorder.

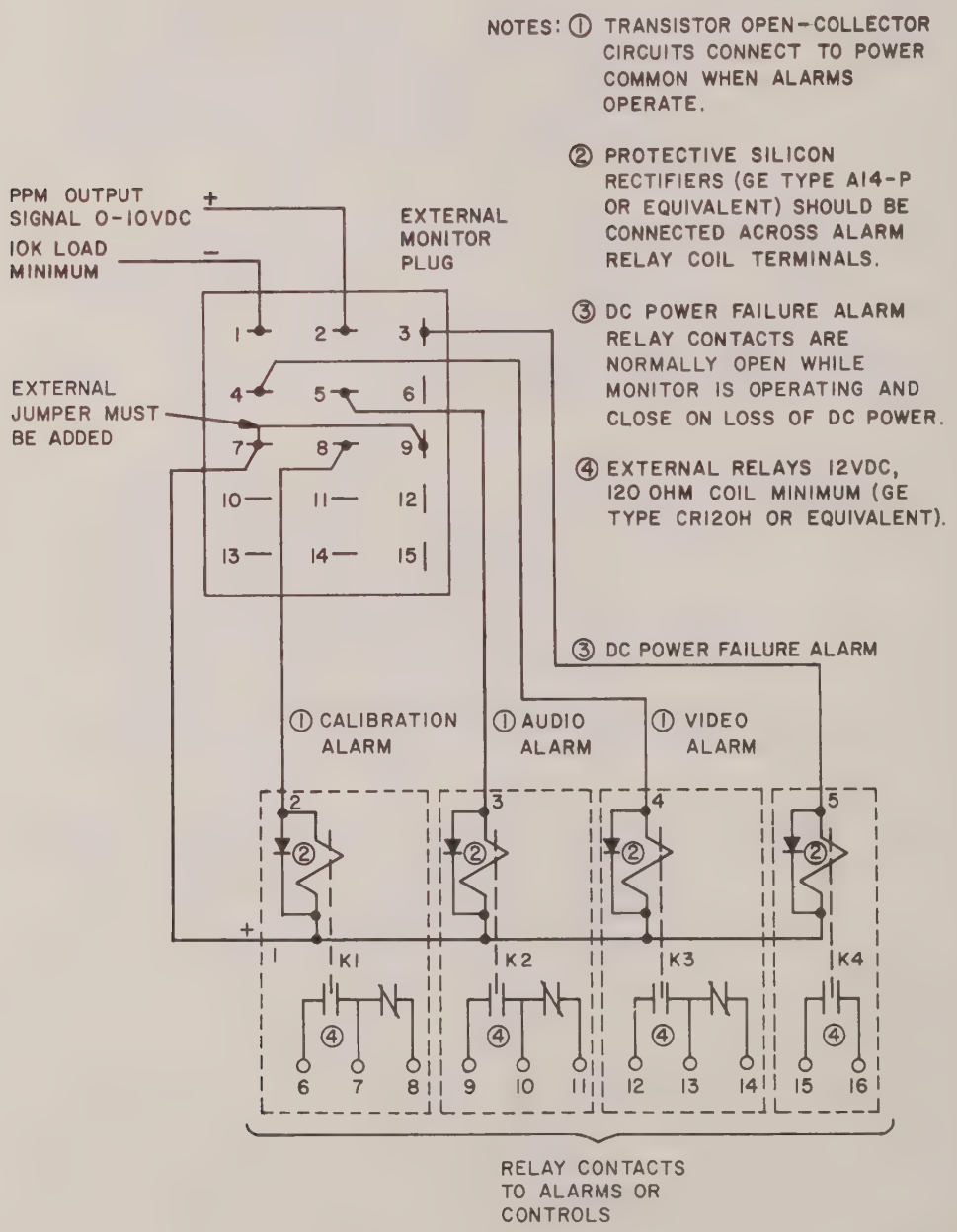

NOTES: ① TRANSISTOR OPEN-COLLECTOR CIRCUITS CONNECT TO POWER COMMON WHEN ALARMS OPERATE.
② PROTECTIVE SILICON RECTIFIERS (GE TYPE A14-P OR EQUIVALENT) SHOULD BE CONNECTED ACROSS ALARM RELAY COIL TERMINALS.
③ DC POWER FAILURE ALARM RELAY CONTACTS ARE NORMALLY OPEN WHILE MONITOR IS OPERATING AND CLOSE ON LOSS OF DC POWER.
④ EXTERNAL RELAYS 12VDC, 120 OHM COIL MINIMUM (GE TYPE CR120H OR EQUIVALENT).
PPM OUTPUT SIGNAL 0-10VDC
10K LOAD MINIMUM
EXTERNAL MONITOR PLUG
EXTERNAL JUMPER MUST BE ADDED
③ DC POWER FAILURE ALARM
① CALIBRATION ALARM
① AUDIO ALARM
① VIDEO ALARM
K1
K2
K3
K4
RELAY CONTACTS TO ALARMS OR CONTROLS

Figure 4-1. Internally Powered Alarm Relay Connection Diagram

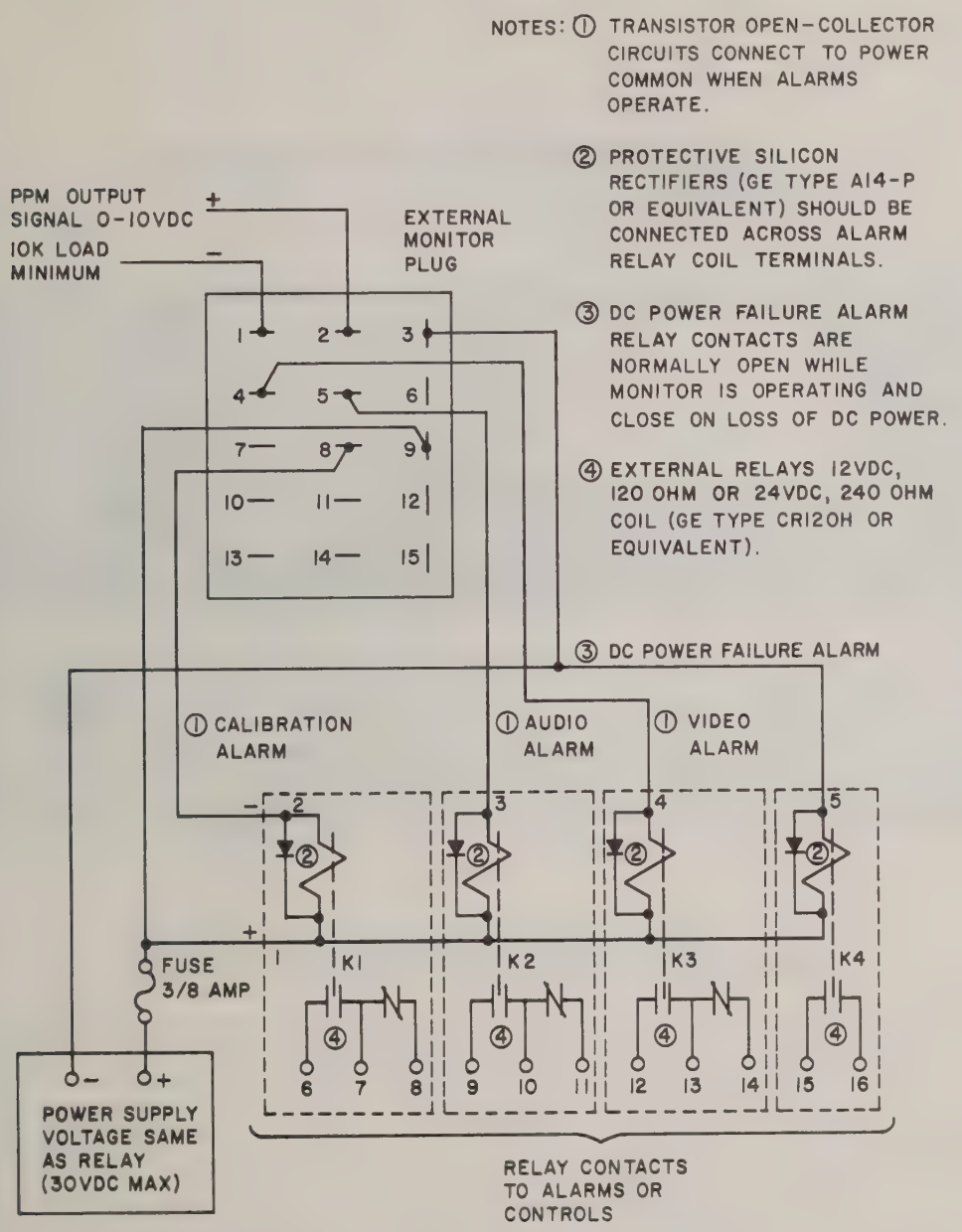

NOTES: ① TRANSISTOR OPEN-COLLECTOR CIRCUITS CONNECT TO POWER COMMON WHEN ALARMS OPERATE.
② PROTECTIVE SILICON RECTIFIERS (GE TYPE A14-P OR EQUIVALENT) SHOULD BE CONNECTED ACROSS ALARM RELAY COIL TERMINALS.
③ DC POWER FAILURE ALARM RELAY CONTACTS ARE NORMALLY OPEN WHILE MONITOR IS OPERATING AND CLOSE ON LOSS OF DC POWER.
④ EXTERNAL RELAYS 12VDC, 120 OHM OR 24VDC, 240 OHM COIL (GE TYPE CR120H OR EQUIVALENT).
PPM OUTPUT SIGNAL 0-10VDC
10K LOAD MINIMUM
EXTERNAL MONITOR PLUG
③ DC POWER FAILURE ALARM
① CALIBRATION ALARM
① AUDIO ALARM
① VIDEO ALARM
FUSE 3/8 AMP
K1
K2
K3
K4
POWER SUPPLY VOLTAGE SAME AS RELAY (30VDC MAX)
RELAY CONTACTS TO ALARMS OR CONTROLS

Figure 4-2. Externally Powered Alarm Relay Connection Diagram

4.1.2 Installing External Calibration Tank of Gas

1. Set INT REF/EXT REF/ZERO GAS switch (23, Figure 4-3, Table 4-1) to EXT REF position.

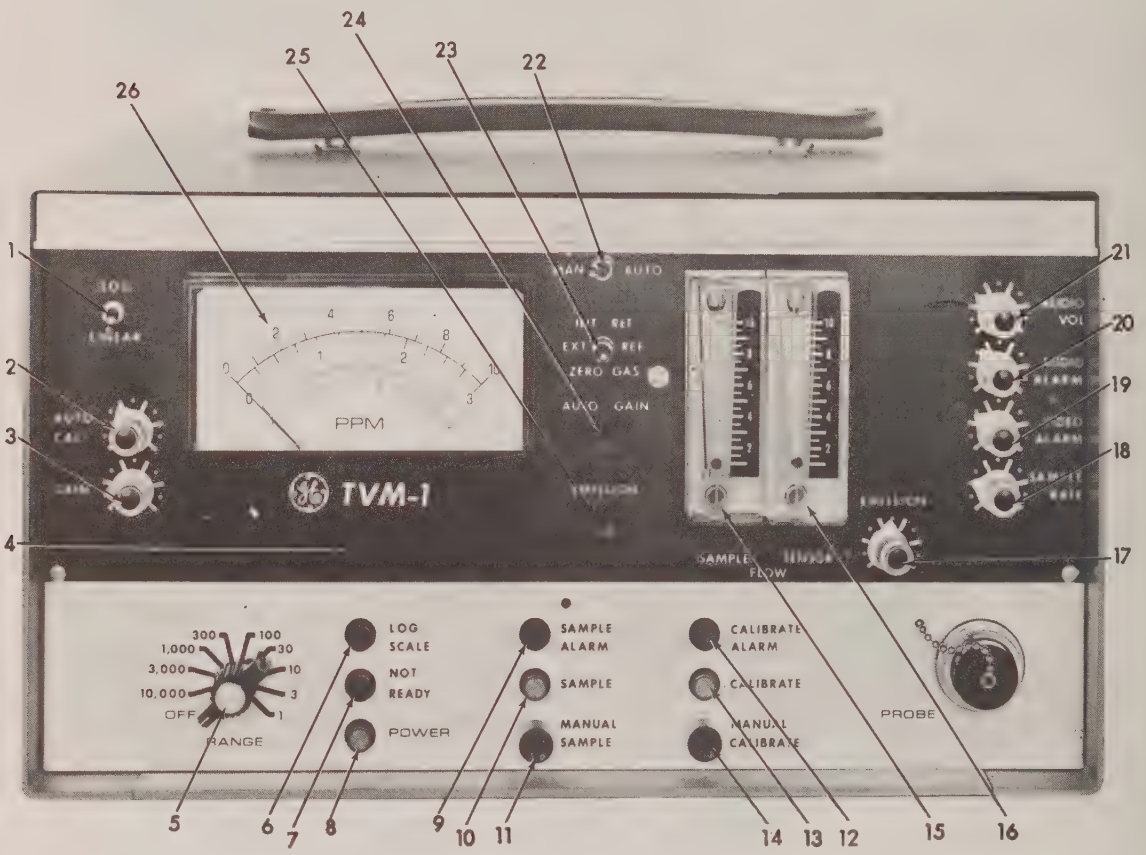


Figure 4-3. Calibration Controls

Table 4-1. Calibration Controls

Figure 4-3 Item	Control	Function
1	LOG/LINEAR switch	Selects scale on PPM meter and lights LOG SCALE lamp when in LOG position.
2	AUTO CAL control	Sets calibration gas set point on PPM meter.
3	GAIN control	Sets gain of amplifier circuits.
4	PPM meter zero set screw	Sets PPM meter to indicate zero and 0.1 when monitor is off.
5	RANGE switch	Controls instrument power and selection of one of nine meter ranges.

SECTION VIII

SERVICING

8.1 TROUBLESHOOTING

In the event of monitor malfunction or failure to meet calibration specifications, the monitor should be removed from service. The following procedures will assist the user in quickly isolating the faulty modules and/or component parts. If the user does not care to troubleshoot and repair the monitor, refer to the Foreword for information concerning the return of the monitor to General Electric Repair Centers. A knowledge of the correct operation and design functions of the various sections, modules, and components of the monitor can be obtained by reading the principles of operation contained in Section VI.

WARNING: REMOVE POWER CORD WHEN SERVICING. IF POWER CORD IS PLUGGED INTO RECEPTACLE, DANGEROUS POTENTIALS EXIST IN CHASSIS, EVEN WHEN POWER ON/OFF SWITCH IS AT OFF POSITION.

Before troubleshooting the TVM-1 Toxic Vapor Monitor, check that the installation and calibrating instructions of Section IV and the maintenance procedures of Section VII have been correctly performed. Faults are isolated to major assemblies such as the pump assembly, main manifold, sample manifold, printed circuit board, or easily replaced components such as the transformer, speaker, PPM meter, or panel indicators and switches. Refer to Table 8-1 for detailed troubleshooting procedures.

Table 8-1. TVM-1 Monitor Troubleshooting Chart

REMOVE POWER CORD WHEN SERVICING

TROUBLE	PROBABLE CAUSE	SUGGESTED REMEDY
POWER lamp does not light when RANGE switch is in other than OFF position.	1. Power cord not connected.	1. Check that monitor is connected to line power source.
	2. POWER lamp burned out.	2. Replace POWER lamp.
	3. 1½ amp power line fuse blown.	3. Replace power 1½ amp fuse.
	4. Faulty power transformer.	4. Check transformer per paragraph 8.1.5.
LOG SCALE lamp does not light when switch is set to use a log scale.	1. LOG/LINEAR switch is in LINEAR position.	1. Set LOG/LINEAR switch to LOG position.
	2. LOG SCALE lamp is burned out.	2. Replace LOG SCALE lamp.

Table 8-1. TVM-1 Monitor Troubleshooting Chart (Cont.)

TROUBLE	PROBABLE CAUSE	SUGGESTED REMEDY
SAMPLE FLOWmeter is not showing approximate midscale indication.	1. Length of sample line may cause need to adjust flowmeter bypass.	1. Adjust sample flowmeter valve per paragraph 4.2.3.
	2. Long stroke pump inoperative.	2. Check pump per paragraph (8.1.2).
	3. Wrong pump motor speed.	3. Check that Hz switch and VOLTS switch are in correct position.
	4. Incorrect sample flowmeter valve setting.	4. Adjust sample flowmeter valve per paragraph 4.2.3.
	5. Sample line filter blocked.	5. Replace sample line filter per paragraph 7.3.
	6. Tubing cut or damaged.	6. Check tubing.
SENSOR FLOWmeter is not showing approximate midscale indication.	1. Short stroke pump inoperative.	1. Check pump per paragraph 8.1.2.
	2. Wrong pump motor speed.	2. Check that Hz switch and VOLTS switch are in correct position.
	3. Incorrect sensor flowmeter valve setting.	3. Adjust sensor flowmeter valve per paragraph 4.2.3.
	4. Sample gas purifier blocked.	4. Replace sample gas purifier per paragraph 7.1.2.
	5. Sensor not in socket.	5. Check sensor to be seated in socket and hoses connected to socket.
	6. Sample manifold clogged.	6. Perform flow check per paragraph 4.2.3 and replace if necessary.
PPM meter reads below zero or off scale.	1. Incorrect RANGE switch setting.	1. Set RANGE switch to appropriate range.
	2. Dirty purifiers.	2. Replace purifiers per paragraphs 7.1.1 and 7.1.2.
	3. Out of calibrating gas.	3. Replace gas.

Table 4-1. Calibration Controls (Cont.)

Figure 4-3 Item	Control	Function
6	LOG SCALE lamp	Lights when logarithmic PPM display has been selected.
7	NOT READY lamp	Lights when monitor is not ready for manual sample or manual calibration.
8	POWER lamp	Lights when RANGE switch is not in OFF position.
9	SAMPLE ALARM lamp	Flashes when measured PPM level exceeds preset alarm point.
10	SAMPLE lamp	Lights when monitor is in sample measurement mode of operation.
11	MANUAL SAMPLE pushbutton	Initiates sample measurement.
12	CALIBRATE ALARM lamp	Flashes when monitor is out of calibration range.
13	CALIBRATE lamp	Lights when monitor is in calibration mode of operation.
14	MANUAL CALIBRATE pushbutton	Initiates calibration cycle.
15	SAMPLE FLOWmeter	Indicates flow of gas in control loop portion of monitor gas flow system.
16	SENSOR FLOWmeter	Indicates flow of gas in DYNA-LOOP portion of monitor gas flow system.
17	EMISSION control	Sets sensor response level.
18	SAMPLE RATE control	Sets time interval between samples from 2 to 12 minutes.
19	VIDEO ALARM control	Sets point at which SAMPLE ALARM indicator flashes.
20	AUDIO ALARM control	Sets point at which audio alarm sounds.
21	AUDIO VOL control	Sets audio alarm volume.

Table 4-1. Calibration Controls (Cont.)

Figure 4-3 Item	Control	Function
22	MAN/AUTO switch	When in MAN position, connects PPM meter to output of sensor amplifier for calibration check purposes.
23	INT REF/EXT REF/ ZERO GAS switch	Directs flow of gas in monitor for different modes of operation and for zero gas check.
24	AUTO GAIN push-button	Checks level of gain in auto-gain amplifier circuit.
25	EMISSION push-button	Checks level of sensor background current.
26	PPM meter	Indicates magnitude of halogen concentration in PPM with two scale arcs, a black linear arc marked 0-10 and 0-3, and a red logarithmic arc marked 0.1 to 100.

2. Following items are needed to set correct reference gas flow:

   a. Flowmeter, 0-20 cc/sec range.

   b. Tank of gas containing specific halogen to be monitored, mixed with nitrogen in desired PPM range. Gas suppliers such as Matheson, Airco, and Linde will mix and certify as a standard, various concentrations of halogen gas that is to be monitored together with correct regulator for tank.

   c. Clean hose or tubing, such as supplied with monitor.

   d. Quick-disconnect self-sealing fitting (supplied with monitor) with 1/4-inch pipe thread for connection to regulator.

   NOTE: CONNECTIONS AND HOSE FITTINGS MUST BE FREE OF LEAKS, PIPE DOPE, AND SEALING COMPOUNDS. SEALANT TAPE, APPLIED SO THAT NO TAPE IS EXPOSED TO GASFLOW, IS RECOMMENDED.

3. Connect tank, regulator, and hose or tubing together.

4. Connect input port of flowmeter to loose end of tubing leaving discharge side of flowmeter open to atmosphere (see Figure 4-4).

   CAUTION: TAKE APPROPRIATE PRECAUTIONS IF DISCHARGE GAS IS TOXIC.

5. Using tank regulator control valve, set flow to approximately 1.8 cu ft/hr (15 cc/sec).

6. With or without flowmeter in line, connect hose or tubing to external reference gas quick connection on rear of monitor (15, Figure 3-2).

   CAUTION: DO NOT APPLY MORE THAN FIVE POUNDS (2.4 KILOGRAMS) GAGE PRESSURE TO MONITOR.

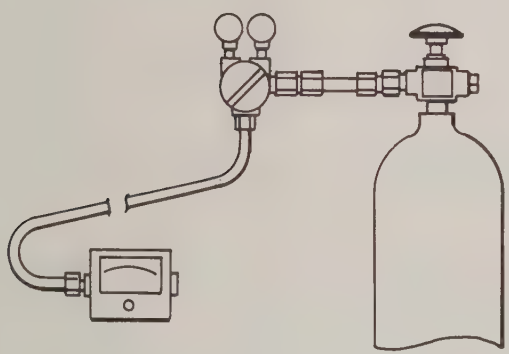


Figure 4-4. Setting of Gas Flow

4.1.3 Installing Internal Calibration Leak Capsule

1. Remove case per paragraph 8.2.1.

2. Open green bypass valve (5, Figure 8-5) on calibrating leak assembly (6), in bottom center of monitor, approximately 1-1/2 turns counter-clockwise.

3. Replace case.

4. Loosen clamp screw on external gas connector (13, Figure 3-2).

5. Remove connector (counterclockwise) and retain for use with external calibration tank of gas.

6. Place thinnest washer of four supplied with capsule on end of calibrating leak assembly and carefully screw capsule into monitor.

7. Face of LEAK FACTOR gage should be parallel with top of monitor for easy viewing. If it is not, either add another washer or a thicker one.

8. Tighten screw in clamp assembly.

NOTE: THE GAGES ARE SET AT THE FACTORY WITH A FACTOR OF ONE, WHICH GIVES THE LEAK RATE AND NOMINAL PPM INDICATED ON THE NAMEPLATE. THE LEAK RATE CAN BE CHANGED BY ADDING MORE GAS TO THE CAPSULE. MULTIPLY THE LEAK RATE OR NOMINAL PPM ON THE NAMEPLATE BY THE LEAK FACTOR (GAGE READING) TO OBTAIN THE NEW LEAK RATE OR NEW NOMINAL PPM.

9. Set INT REF/EXT REF/ZERO GAS switch (23, Figure 4-3) to INT REF position.

4.2 CALIBRATION

NOTE: MONITORS ARE FACTORY CALIBRATED USING 50 PPM OF R-12 REFRIGERANT GAS.

If the monitor is to be used with a gas other than R-12, in the same range of concentration, it must be recalibrated using the actual gas that is to be measured for the reference. Table 4-2 presents approximate relative sensitivity of various detectable gases with reference to R-12. Those gases listed with an M beside the value have been measured in the laboratory. The others have been estimated from a study of chemical formulation.

Table 4-2. Toxic Halogen Gas Vapors Detectable by the TVM-1 Monitor

	Approximate Relative Sensitivity versus R-12
Acetylene tetrabromide	4
Allyl chloride	2
Benzyl chloride	1.1 M
Boron tribromide	3
Bromine	2
Bromine pentafluoride	1
Bromoform-skin	4
Carbon tetrachloride-skin	4.6 M
Chlorine dioxide	2
Chlorine trifluoride	1

Table 4-2. Toxic Halogen Gas Vapors Detectable by the TVM-1 Monitor (Cont.)

	Approximate Relative Sensitivity versus R-12
C Chloroacetaldehyde	1
a-Chloroacetophenone	
Chlorobenzene (monochlorobenzene)	0.9 M
o-Chlorobenzylidene	
Chlorobromomethane	2
Chloroform (trichloromethane)	3.8
1-Chloro-1-nitro-propane	2
Chloropicrin	1
B Chloroprene (2-chloro-1, 3-butadiene)-skin	2
o-chlorotoluene-skin	1
1,2-Dibromoethane (ethylene dibromide)-skin	2
C Dichloracetylene	2
C o-Dichlorobenzene	2
p-Dichlorobenzene	2.0 M
Dichlorodifluoromethane (R-12)	Standard=1.0
1,1-Dichloroethane	2
1,2-Dichloroethane	2
1,2-Dichloroethylene	2
Dichloroethyl ether-skin	2
Dichloromonofluoro methane (R-21)	3
C 1,1-Dichloro-1-nitroethane	2
Dichlorotetrafluoroethane (R-114)	1
Dichlorvos (DDVP)-skin	2
Difluoromonochloromethane (R-22)	1
Difluorodibromomethane	1
Enflurane	1
Epichlorhydrin-skin	2
Ethyl bromide	1
C Ethylene chlorohydrin-skin	2
Fluorotrichloromethane	3.4
Halothane	1
Hydrogen bromide	0.7 M
C Hydrogen chloride	1.3 M
Lindane-skin	7
Methyl bromide-skin	0.6 M
Methyl chloride	0.6 M
Methyl chloroform	4
Methylene chloride	1.6 M
Perchloroethylene-skin	3.6 M
Perchloromethyl mercaptan	4
Perchloryl fluoride	1
Phosgene (carbonyl chloride)	2
Phosphorus trichloride	4

Table 4-2. Toxic Halogen Gas Vapors Detectable by the TVM-1 Monitor (Cont.)

	Approximate Relative Sensitivity versus R-12
Propylene dichloride (1,2-dichloropropane)	2
Sulfur hexafluoride	0.01 M
Sulfur monochloride	2
1,1,1,2-Tetrachloro-2, 2-difluoroethane	4
Trichloroethylene	3
1,1,1-Trichloroethane (methyl chloroform)	4
1,1,1,2 Tetrachloro-2, difluoroethane (R-112)	4
1,1,2-Trichloro 1,2,2-trifluoroethane (Freon 113)	2
Trifluoromonobromomethane	1
1,1,2-Trichloro 1,2,2-trifluoroethane	3
1,2,3-Trichloropropane	3
Vinyl Bromide	2
Vinyl chloride	2
Vinylidene chloride	2

4.2.1 Initial Control Setting

Loosen hinged front cover locking screw (21, Figure 3-1), raise the cover, and set monitor controls to following positions:

Figure 4-3 Item	Control	Position
1	LOG/LINEAR	LINEAR
2	AUTO CAL	Middle of range
3	GAIN	1/4 of range
17	EMISSION	Full counterclockwise
18	SAMPLE RATE	Full counterclockwise
19	VIDEO ALARM	Full clockwise
20	AUDIO ALARM	Full clockwise
21	AUDIO VOL	Full counterclockwise
22	MAN/AUTO	AUTO

4.2.2 RANGE Switch Setting

1. Turn RANGE switch (5, Figure 4-3) to desired PPM range.

2. Observe that POWER lamp (8) lights.

3. Allow a minimum of 10 minutes for warmup.

NOTE: UNDER NORMAL OPERATING CONDITIONS, THE MONITOR IS READY FOR USE AFTER TEN MINUTES WARMUP. HOWEVER, AFTER 24 HOURS OF SHUTDOWN, IT IS RECOMMENDED THAT THE WARMUP BE INCREASED TO TWENTY MINUTES WITH NO CALIBRATION ADJUSTMENTS ATTEMPTED DURING THIS PERIOD. THE MONITOR HAS A BUILT-IN AUTO-CALIBRATE STARTUP CIRCUIT. NINETY SECONDS AFTER POWER IS APPLIED, MONITOR AUTOMATICALLY GOES INTO A CALIBRATION SEQUENCE.

4.2.3 SENSOR FLOWmeter and SAMPLE FLOWmeter Setting

Check SAMPLE FLOWmeter and SENSOR FLOWmeter (15 and 16, Figure 4-3) for approximately midscale indications.

NOTE: THE SAMPLE FLOW, IN MONITORING INSTALLATION, MAY BE MORE OR LESS THAN MIDSCALE DEPENDING ON THE LENGTH OF SAMPLE TUBING, HOWEVER, THE FLOWMETER SHOULD INDICATE SOME FLOW. THE LOWER FLOW RATES CAUSE A GREATER LAG TIME IN INDICATING A GAS CONCENTRATION CHANGE THAT HAS OCCURRED AT ACTUAL SAMPLE ENTRY POINT. IF FLOWS ARE NOT CORRECT, REFER TO FIGURE 8-6 AND ADJUST FLOWMETER NEEDLE VALVES FOR AN APPROXIMATE MIDSCALE READING OF THE FLOWMETERS.

4.2.4 EMISSION Control Setting

1. For ranges from 300 to 10,000 PPM, turn RANGE switch (5, Figure 4-3) to 100 position.

2. Observe that NOT READY (7), SAMPLE (10), and CALIBRATE (13), lamps are not lit. (NOT READY lamp may light temporarily when setting range switch.)

3. Press and hold EMISSION pushbutton (25).

4. Observe emission reading of 0.5 (approximately) on top linear 0-10 scale of PPM meter (26).

5. Slowly turn EMISSION control clockwise and after a small lag, observe PPM meter needle begin to move up scale.

6. Immediately return EMISSION control to full counterclockwise position and allow PPM meter to return to minimum reading.

7. Turn EMISSION control again clockwise to obtain a slightly positive (0.1 to 1) reading on top linear 0-10 scale of PPM meter.

8. Release EMISSION pushbutton.

9. Return RANGE switch to correct range setting.

4.2.5 AUTO CAL Control Setting

Turn AUTO CAL control (2, Figure 4-3) to position corresponding to value of standard calibration gas or calculated concentration of internal standard. (For example, with RANGE switch (5) on 100 linear scale and a reference gas of 50 PPM, AUTO CAL control should be set to middle of range.)

4.2.6 MANUAL CALIBRATE Check

1. Press MANUAL CALIBRATE pushbutton (14, Figure 4-3) and release.

2. Observe following:

   a. CALIBRATE lamp (13) lights for a full cycle until SAMPLE lamp (10) lights within a minimum of 2 minutes after MANUAL CALIBRATE pushbutton is released.

   b. PPM meter (26) will pass through following indication phases while CALIBRATE lamp is lit.

      For Catalog No. 50-423103FAFF1 and 50-423103FAFF2:

      (1) First phase, approximately 65 seconds after CALIBRATE lamp lights, will be a reading of greater than 9 on top linear 0-10 scale. (This is a calibration marker for recorders.)

      (2) Second phase, approximately 30 seconds later, meter will indicate a calibration sample reading anywhere up to and including full scale.

      (3) Third phase, approximately 30 seconds later, will indicate a calibration level corresponding to the AUTO CAL control position as set in paragraph 4.2.5. This reading will remain displayed until SAMPLE lamp extinguishes at end of first sample cycle.

      For Catalog No. 50-423103FAFF3:

      When set up for single point monitoring, operates the same as for Catalog No. 50-423103FAFF1 and 50-423103FAFF2. When set up for a multipoint scanner the first phase is omitted, and the second phase is entered approximately 90 seconds after pressing the MANUAL CALIBRATE pushbutton.

   c. The calibration reading should agree with concentration of standard gas. If it does not, AUTO CAL control (2) setting should be checked.

d. If CALIBRATE ALARM lamp (12) is flashing, check and adjust AUTO GAIN control as described in paragraph 4.2.7.

4.2.7 AUTO GAIN Setting

1. Momentarily press AUTO GAIN pushbutton (24, Figure 4-3) and observe PPM meter (26) reading on top linear 0-10 scale.

2. If reading is between 1 and 3, reading is correct; disregard following steps and proceed with paragraph 4.2.9.

3. If reading is greater than 3, rotate GAIN control (3) clockwise approximately one division.

4. If reading is less than 1, rotate GAIN control counterclockwise approximately one division.

5. Press and release MANUAL CALIBRATE, pushbutton (14).

6. Wait two minutes for monitor to go through calibrate cycle and press AUTO GAIN pushbutton to obtain new PPM meter reading on top linear 0-10 scale.

7. If this reading is not between 1 and 3, repeat steps 3 through 7 until GAIN control is at end of its limit.

8. If reading is still not between 1 and 3, reset GAIN control to 1/4 of its range.

9. Turn EMISSION control (17) either one division clockwise to lower reading or one division counterclockwise to raise reading.

10. Repeat steps 8 and 9 until a reading between 1 and 3 is obtained, or full range of GAIN control has been reached, or EMISSION control has reached a plateau where no further change in sensitivity is obtained.

11. If full range of GAIN and EMISSION controls have been tried and AUTO GAIN reading of 1 to 3 has not been obtained, a PPM valve adjustment may be required. See paragraph 4.2.8.

4.2.8 PPM Valve Adjustment

The PPM valve controls the proportion of sample gas which is introduced to the DYNA-LOOP and is factory adjusted to give nominal gain and auto gain settings with a new sensor and with 50 PPM of R-12 calibration gas. For gases with relative responses much different from R-12 or with an aging sensor, the PPM valve may require adjustment.

If unable to obtain appropriate gain settings in accordance with paragraph 4.2.7, adjust PPM valve as follows:

1. Check that EMISSION control (17, Figure 4-3) is set in accordance with paragraph 4.2.4.

2. Set GAIN control (3) to 1/4 scale position.

3. Loosen locknut on red PPM valve of sample manifold (see Figure 8-6).

4. Set MAN/AUTO switch (22, Figure 4-3) to MAN position and observe that reading on top linear 0-10 scale of PPM meter is approximately 0.0 when SAMPLE, CALIBRATE, and NOT READY lamps are out. If PPM meter does not read approximately 0.0, refer to paragraph 4.2.11 and perform a ZERO GAS check.

5. Press MANUAL CALIBRATE pushbutton (14), and after approximately 65 seconds the PPM meter will respond to calibration gas sample by moving up scale and settling at a reading of approximately 0.6 to 1.0 for about 20 seconds before decreasing.

6. During this 20 second period adjust the PPM valve very slightly (clockwise to decrease or counterclockwise to increase reading) as required to obtain reading of 0.6 to 1.0.

7. Repeat steps 5 and 6 as necessary to obtain correct reading, then tighten PPM valve locknut.

8. After tightening locknut repeat step 5 to assure that PPM valve setting has not been disturbed in tightening.

9. Return MAN/AUTO switch to AUTO position.

10. Press and release MANUAL CALIBRATE pushbutton, and after two minutes press and hold AUTO GAIN pushbutton (24) to observe PPM meter reading of between 1 and 3 on top linear scale.

11. If reading is between 1 and 3, refer to paragraph 4.2.9 to set alarm; if not, readjust GAIN in accordance with paragraph 4.2.7.

NOTE: THE IDEAL PPM VALVE ADJUSTMENT WILL RESULT IN AN AUTO GAIN READING OF 2 WITH GAIN CONTROL AT 1/4 RANGE AND A SMALL POSITIVE EMISSION READING. THE AUTO GAIN SETTING (PARAGRAPH 4.2.7) AND PPM VALVE ADJUSTMENT (PARAGRAPH 4.2.8) PROCEDURES MAY HAVE TO BE REPEATED TO APPROACH THE DESIRED SETTINGS.

4.2.9 AUDIO ALARM Control and VIDEO ALARM Control Setting

NOTE: ALARM SET POINTS ARE ESTABLISHED BY SETTING CONTROL KNOBS TO DESIRED SET POINT. (MARKS AROUND CONTROLS CORRESPOND TO PPM METER SCALE.)

1. Perform one of following initial steps:

   a. If an external reference gas tank (could be calibration tank) is available to provide a test sample, check that its flow is less than 15 cc/sec (per paragraph 4.1.2) and connect it to monitor sample line coupler.

   b. If a remote leak standard is available, connect monitor survey probe to sample it.

2. Press and release MANUAL SAMPLE pushbutton (11, Figure 4-3).

3. Observe PPM meter (26) reading which should be within 10 percent of AUTO CAL control (2) setting.

4. Turn AUDIO VOL control (21) to 1/4 of range.

5. Turn AUDIO ALARM control (20) above and below PPM meter indication to check that AUDIO ALARM sounds.

6. With alarm sounding, turn AUDIO VOL control full clockwise to check full volume and then counterclockwise to check low volume point.

7. Turn VIDEO ALARM control (19) to just below PPM meter indication and check that SAMPLE ALARM lamp (9) lights and extinguishes as control is turned above and below meter indication.

8. Turn AUDIO VOL, AUDIO ALARM, and VIDEO ALARM controls to desired set points.

9. If external reference gas was used, reconnect external gas and sample line to original connections.

4.2.10 LOG/LINEAR Switch Setting

1. If linear scale is to be used, set LOG/LINEAR switch to LINEAR position.

2. If log scale is to be used, AUTO CAL control (2) must be adjusted.

3. Set LOG/LINEAR switch (1, Figure 4-3) to LOG position.

4. Observe that LOG SCALE lamp (6) lights.

5. Rotate AUTO CAL control (2) to a position corresponding with the desired log scale reading. (For example, on linear scale when using a 50 PPM reference gas, with RANGE switch (5) set on 100, AUTO CAL control would be adjusted to give a reading of 5 (corresponding to 50 PPM) on top linear 0-10 scale. However, for a log scale, AUTO CAL control would have to be readjusted to give a reading of 50 on log scale which would be same as 9 on top linear 0-10 scale.

   NOTE: FOR DIRECT READING OF LOG SCALE ON PPM METER, SET RANGE SWITCH TO 1, 10, 100, 1000, or 10,000 AND MULTIPLY READING BY RANGE SWITCH SETTING DIVIDED BY 100. AVOID USE OF 3, 30, 300, AND 3000 RANGES WHEN USING LOG SCALE DUE TO SCALE FACTOR.

6. Press MANUAL CALIBRATE pushbutton (14), and observe that a correct log scale reading is obtained.

7. After two minutes, press AUTO GAIN pushbutton and observe a reading between 1 and 3 on top linear 0-10 scale of PPM meter is obtained, if not, refer to paragraph 4.2.7 and repeat until proper conditions are met.

4.2.11 ZERO GAS Check

1. Press and hold INT REF/EXT REF/ZERO GAS switch (23, Figure 4-3) down in ZERO GAS position until step 5 is reached.

2. After 5 seconds, press and release MANUAL SAMPLE pushbutton (11).

3. Observe PPM meter (26) reading approaching zero, if it does not, repeat procedure three times.

4. If PPM meter reading still does not approach zero, purifiers may be contaminated. See paragraph 7.1.

5. Return INT REF/EXT REF/ZERO GAS switch to original position.

4.2.12 Survey Probe Check

1. Observe SAMPLE FLOWmeter (12, Figure 3-1) reading greater than zero.

2. Press and release probe sample switch (15) and observe that SAMPLE lamp (10, Figure 4-3) lights.

3. If reference gas is available, use probe to sample reference.

4. Turn VIDEO ALARM control (19), counterclockwise until PPM meter (26) indication dips.

5. Check that probe alarm indicator lights and extinguishes as control is turned above and below PPM meter indication.

6. Reset VIDEO ALARM control to desired set point.

4.2.13 CALIBRATE ALARM Lamp Check

1. Press and release MANUAL CALIBRATE pushbutton (14, Figure 4-3).

2. Observe AUTO CAL control (2) and RANGE switch (5) positions.

3. Wait two minutes and move RANGE switch clockwise one position.

4. Turn AUTO CAL control to midrange.

5. Press and hold AUTO GAIN pushbutton (24).

6. Turn AUTO CAL control clockwise and counterclockwise observing CALIBRATE ALARM lamp (12) lights and extinguishes as meter pointer indicates above and below 0.4 on top linear 0-10 scale of PPM meter (26).

7. Set RANGE switch up two positions and repeat step 6 except turn AUTO CAL control to obtain a reading above and below 9.8 on top linear 0-10 scale.

8. Reset RANGE switch and AUTO CAL control to original positions.

9. Press and release MANUAL CALIBRATE pushbutton and observe readings during calibration.

4.2.14 SAMPLE RATE Control Setting

With the SAMPLE RATE control (18, Figure 4-3) set fully counterclockwise the time between automatically initiated samples is approximately 12 minutes. With the SAMPLE RATE control set fully clockwise the time between samples is decreased to approximately 2 minutes. Set sample rate to the desired interval, time the sampling rate, and readjust the SAMPLE RATE control until the desired interval is reached.

Because the SAMPLE RATE control establishes the rate at which samples are taken, the SAMPLE RATE control should be set fully counterclockwise when using the survey probe.

SECTION V

OPERATION

After completing the Installation and Calibration procedures presented in Section IV, the monitor is ready for operation.

5.1 NORMAL OPERATION

One of the features of the monitor is that it is an automatically self-calibrating instrument once it has been initially calibrated.

When the monitor is operating, it will automatically sample at a time interval set during calibration of between 2 and 12 minutes. The PPM meter (26, Figure 4-3) may be read anytime that the SAMPLE (10) or CALIBRATE (13) lamps are not lit. The audio and visual alarms will indicate when sample measurements are above preset levels and will continue to operate until a measurement is indicated below this preset level.

5.2 MANUAL OPERATION

The monitor may also be used to manually obtain a sample measurement of a gas by pressing the MANUAL SAMPLE pushbutton (11, Figure 4-3) or to manually calibrate by pressing the MANUAL CALIBRATE pushbutton (14) when the SAMPLE (10), CALIBRATE (13), CALIBRATE ALARM (12), or NOT READY (7) lamps are not lit.

5.3 PORTABLE OPERATION

If a survey probe is being used, press and release the sample pushbutton (15, Figure 3-1) on the probe handle to initiate a measurement. Observe that the SAMPLE lamp (7) on the monitor is lit. When the lamp extinguishes, read the PPM on the meter (1). Survey probe sample alarm lamp (14) on the probe and SAMPLE ALARM lamp (6) on the front panel of the monitor will light when the PPM exceeds the video alarm setting.

NOTE: A MINIMUM OF 2 MINUTES BETWEEN MANUAL SAMPLES IS REQUIRED FOR BEST ACCURACY.

SECTION VI

PRINCIPLES OF OPERATION

Figure 6-1 shows the fundamental operating principle of the TVM-1 Toxic Vapor Monitor. A very minute amount of sample gas enters the sensor. If halogen is detected, a signal is sent to the signal amplifier which has an automatic zero feature built-in to maintain the monitor at a preset reference level. This level is used by the automatic calibrating circuit.

The amplified signal is sent to the output peak read, measure, and hold amplifier which has an automatic gain control. The automatic calibrate, measure, and hold amplifier provides automatic self calibration of the monitor. All three of these amplifier circuits are mounted on the amplifier printed circuit board.

The logic circuits that provide automatic timing for the sampling and calibrating sequences of the monitor are mounted on the alarm and logic printed circuit board. The audio signal, video signal, and calibrate alarm circuits are also mounted on this board.

The sensor heater control circuit together with the power supply circuits are mounted on the power supply and sensor printed circuit board. The PPM output meter that displays a referenced amplified signal that is proportional to the detected halogen gas is mounted on the front panel of the monitor.

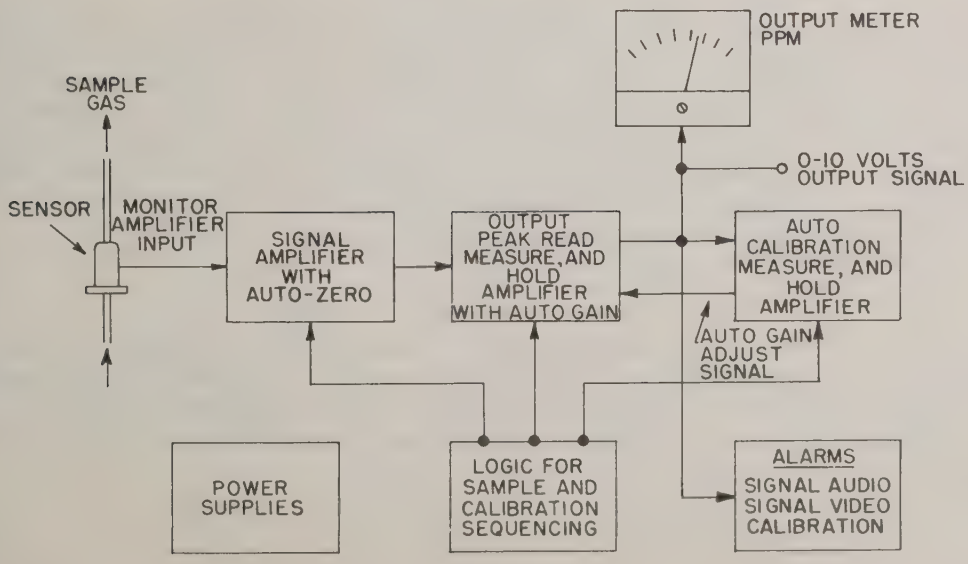


Figure 6-1. Toxic Vapor Monitor Block Diagram

6.1 HEATER CONTROL CIRCUIT

The heater in the sensor is energized with a regulated current to maintain a constant sensor temperature. This provides a sensor output which is not affected by line-voltage variations, shortens warm-up time for cold sensors, and minimizes sensor output drift.

Since the platinum heater has a temperature coefficient of resistance of ±0.3% per degree C, a resistance-bridge circuit is used to maintain constant temperature. The four arms of the resistance bridge (Figure 8-1) are: the sensor heater; a 0.4-ohm resistor R2; the heater temperature-adjusting potentiometer R3 together with a fixed resistor R4; and fixed resistor R5. This bridge circuit employs an operational amplifier A4.

6.2 SENSOR

The monitor has a sensor which is essentially a diode consisting of an emitter (sometimes called the heater) and a collector. The collector is a rod suspended in a powdered-alkali metal core material housed in a concentric platinum tube. The tube and rod are connected by a welded platinum strip, thus keeping rod and tubing at the same potential. This assembly is encased as an insulated core in a coiled-wire heater assembly wrapped on four ceramic posts to create an insulated heat source.

When current is applied to the coiled heater wire, the temperature of the sensor assembly is raised to approximately 900°C, causing a small current to flow in the core rod. This small current flow, which is due to ionization of the core material, increases linearly to a useful limit in proportion to the amount of halogen in the air or gas passed through the assembly. Beyond this limit, however, the increase in current is extremely nonlinear and excessive increases in halogen in the gas only serve to shorten the life of the sensor.

The actual current between emitter and collector (with and without halogen present in the assembly) is very low, and a high gain amplifier circuit is used to generate a proportional signal which is displayed on the PPM meter to provide a visual indication in parts per million of the halogen that is present. The amplified signal is also used to trigger an audible alarm through a speaker and a visible alarm through a solid-state, survey probe sample alarm light (14, Figure 3-1) on the hand-held survey probe and the SAMPLE ALARM lamp (6) on the front panel of the monitor.

6.3 TIMING

Figure 6-2 is a timing diagram which illustrates the sequence of monitor operation after the MANUAL CALIBRATE pushbutton (11, Figure 3-1) is pressed. The CALIBRATE lamp (10) lights for a period 2 to 12 minutes (depending on the sample rate - see paragraph 4.2.14) and then the SAMPLE lamp (7) lights.

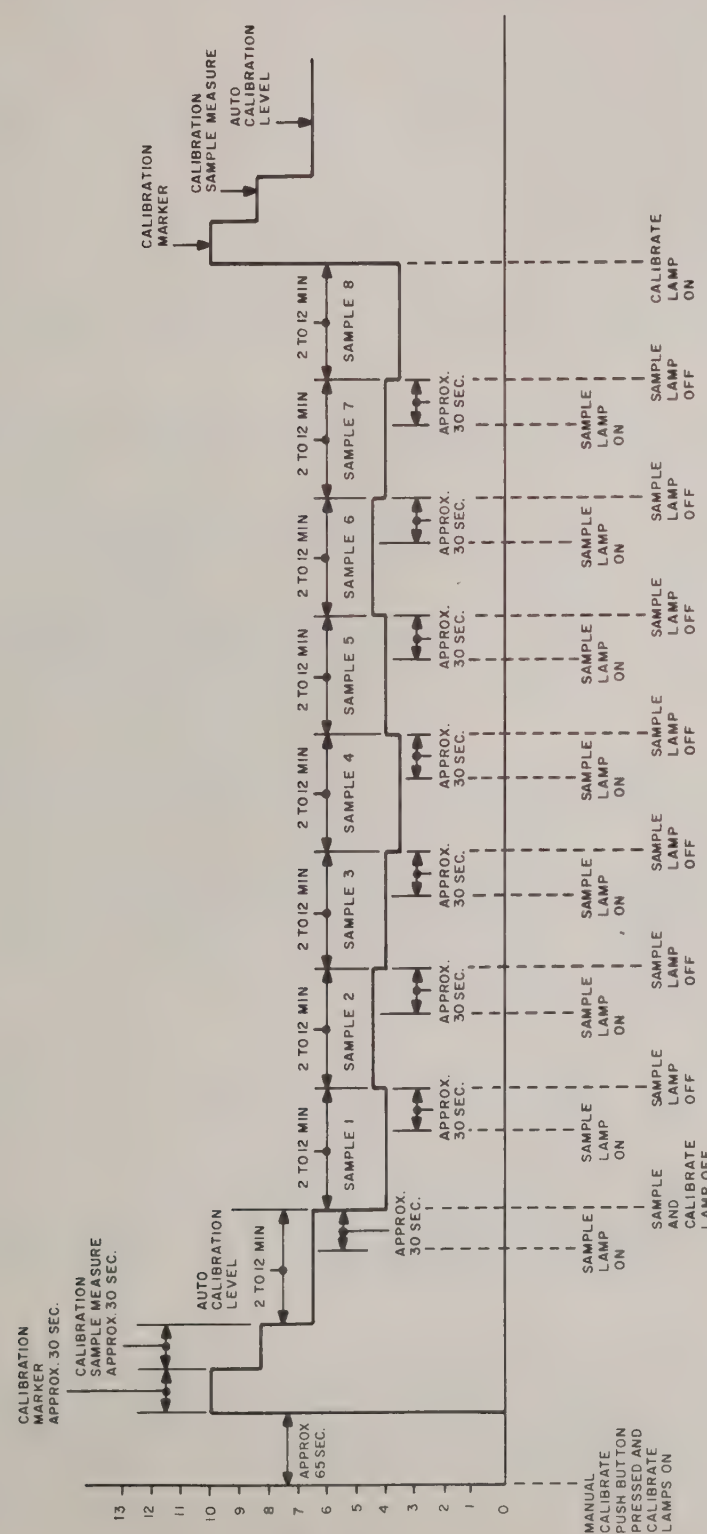


Figure 6-2. Timing Diagram

After the CALIBRATE lamp lights, the PPM meter (1) will show the following successive readings:

1. After approximately 65 seconds, a reading greater than 9 on the top linear 0-10 scale of the PPM meter occurs for use as a calibration marker for external recorders.

2. Approximately 30 seconds later, a calibration sample reading occurs on the top linear 0-10 scale of the PPM meter.

3. Approximately another 30 seconds later, a preset autocalibration level reading occurs. (see paragraph 4.2.5).

4. Approximately 30 seconds before the end of the preset 2 to 12 minute interval set as part of the calibration sequence, the SAMPLE lamp lights indicating a sample is being taken.

5. At the end of the calibration sequence both the SAMPLE and CALIBRATE lamps extinguish and sample number 1 is indicated on the PPM meter and/or recorder.

6. Samples number 2 through 8 are correspondingly taken with the SAMPLE lamp alternating between on and off as each sample is taken and then displayed.

7. Upon completion of sample number 8, the CALIBRATE lamp lights and the system begins its next complete autocalibrate and sample cycle.

NOTE: TIMING FOR CATALOG NO. 50-423103FAFF3 MONITORS IS THE SAME AS DESCRIBED ABOVE, EXCEPT THAT, WHEN SET UP WITH A MULTIPOINT SCANNER, A CALIBRATION MARKER (STEP 1) IS NOT USED AND THE TIME FOR SAMPLE NUMBER 8 DISPLAY IS EXTENDED BY 30 SECONDS.

6.4 AIR FLOW SYSTEM

The airflow system consists of four major subassemblies; the pump assembly, the sample manifold, the main manifold, and the calibrating leak assembly.

The pump assembly has two pumps driven by the same motor. One of the pumps (the long stroke pump) draws samples from the area to be monitored and either draws or pushes air through the main manifold. The second pump (the short stroke pump) is used to circulate both air and samples around the DYNA-LOOP.

The sample manifold controls the flow in the DYNA-LOOP by means of the sensor flowmeter and PPM valves that are set during calibration, the differential and flow and bleeder valves that are set after pump installation, and the balance valve that is factory set. Sample manifold connection ports 1 through 4 and A through D are illustrated in Figures 6-3 through 6-7 and 8-8.

The calibrating leak assembly controls the flow of clean air as calibrating gas for use during automatic calibration of the monitor. This assembly contains two valves, a relief valve and a green calibrate bypass valve. The bypass valve is only used in conjunction with an internal calibration leak capsule.

The main manifold controls the flow in the control loop and establishes the flow for each of five modes of monitor operation. It contains the zero gas, sample, and calibrate solenoid valves that operate in conjunction with the monitors electronics and the sample flowmeter adjustment valve that is set during calibration. Main manifold connection ports 1 through 10 are illustrated in Figures 6-3 through 6-7 and 8-8. The five monitor operating modes controlled by the main manifold are as follows:

1. No sample, no calibrate sequence.

2. Sample sequence.

3. Calibration with external gas supply.

4. Zero gas sequence.

5. Calibration with internal gas supply.

6.4.1 No Sample, No Calibrate Sequence

Figure 6-3 illustrates the airflow through the monitor in the no sample no calibrate mode of operation. During this mode of operation no sampling and no calibrating is being done. Sample gas is constantly circulated through the control loop to provide a continuously fresh sample in the monitor and pure air is circulated through the DYNA-LOOP to keep the sensor purified.

Sample gas enters the main manifold of the monitor either through the survey probe or from an external sample line. (Both the survey probe and the sample line should not be connected at the same time.) The gas passes through the solenoid operated zero gas valve V2 of the main manifold, through the long stroke pump, through the sample flowmeter, and into the solenoid operated sample valve V1 that is in its normally open position. From sample valve V1 the gas passes into the calibrating leak assembly, to the solenoid operated calibrate valve V4, and out of the exhaust port on the rear of the unit. This circulation constitutes the control loop of the monitor airflow system and ensures that the system always has a ready gas sample. The normal valve seating arrangement allows the sample gas to circulate through the calibrating leak assembly to purge any dead air.

The DYNA-LOOP constitutes the other major airflow path in the monitor normally operating in a closed clean air loop. It is shown as two separate parts only for the purpose of illustration. The ambient air passing through the sensor is maintained at a constant flow and is passed through a purifier to reduce the background to a zero gas state. The DYNA-LOOP consists of the sample manifold, the sensor, the sensor filter, the short stroke pump, the flowmeter, and the purifier.

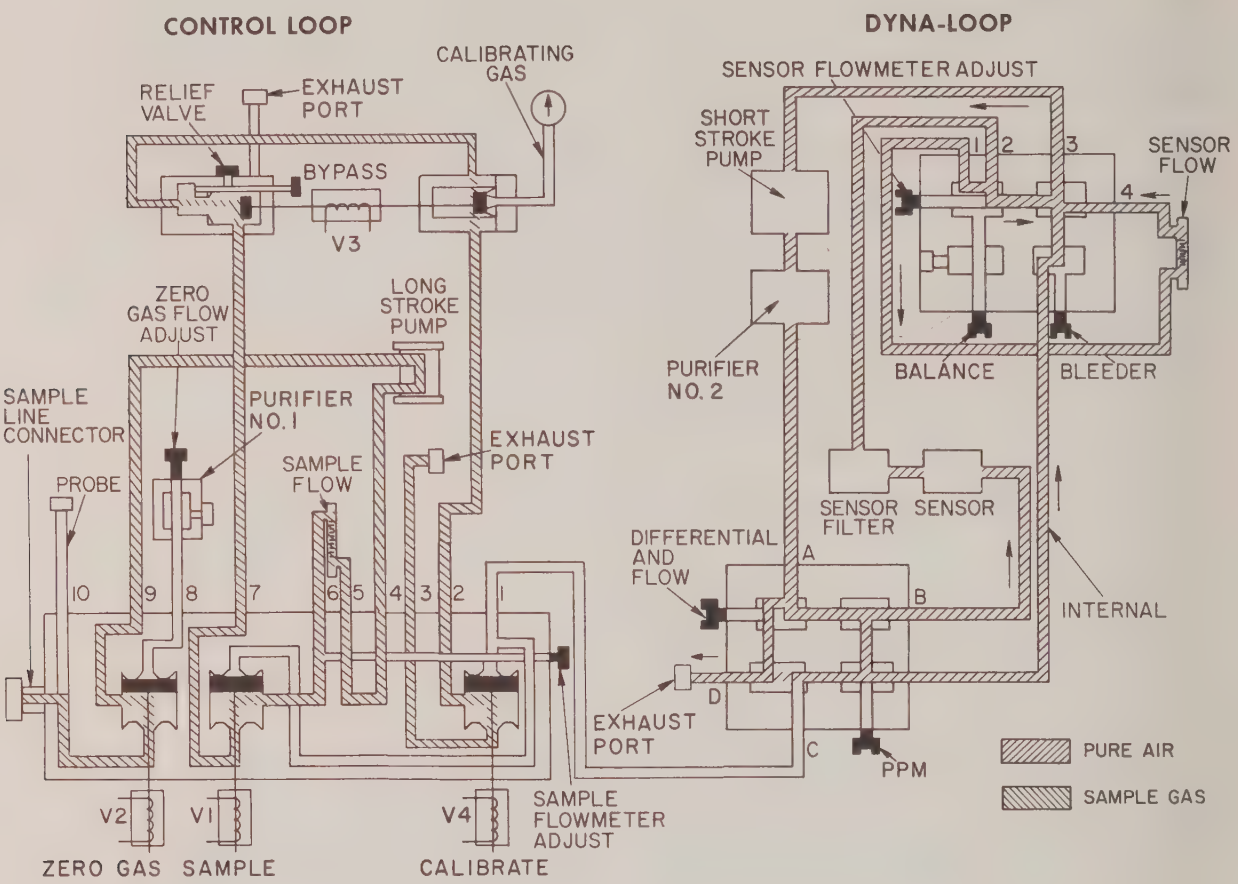


Figure 6-3. No Sample, No Calibrate Sequence

6.4.2 Sample Sequence

Figure 6-4 illustrates the sample sequence mode of operation. When a sample is to be measured, it enters the main manifold through the zero gas valve V2, passes through the long stroke pump, and returns to the manifold through the sample flowmeter to the sample valve V1. As sample valve V1 operates, the sample gas bypasses the rest of the main manifold and enters the DYNA-LOOP.

The sample gas enters the DYNA-LOOP at 10 to 15 cc/sec through port C which is under vacuum, and as the sample gas passes the PPM valve, 1 cc/sec is drawn off to the bleeder valve. A very small portion (less than a tenth of a percent) of the sample gas flowing past the PPM valve to the bleeder valve is drawn into and mixed with the gas in the sensor loop as the result of the loops slightly negative pressure. At this point the sample gas level is measured and the mixed gas is purged from the loop through port D or drawn through the rest of the loop by the short stroke pump and purified to ready the DYNA-LOOP for the next sample.

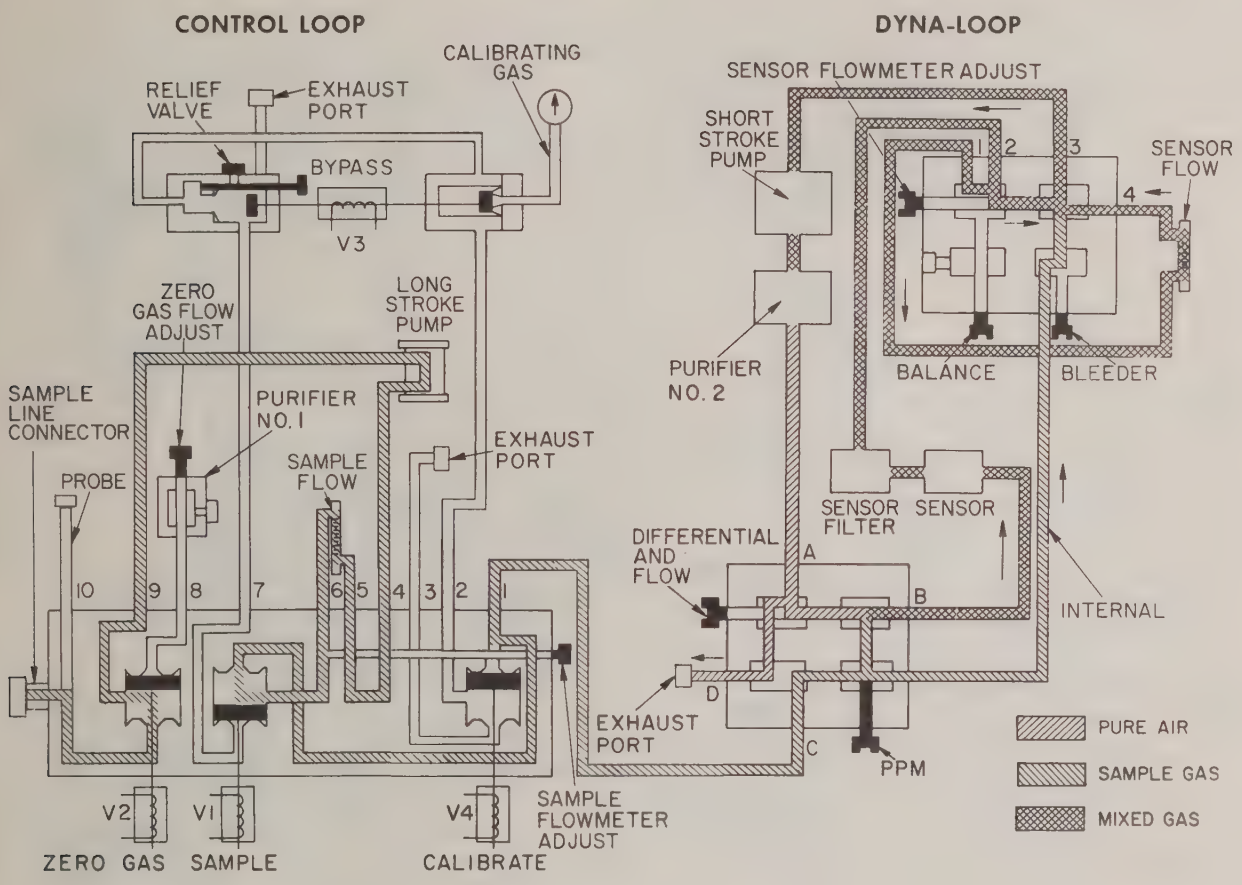


Figure 6-4. Sample Sequence

6.4.3 Calibration With External Gas Supply

Figure 6-5 shows the calibration with external gas supply mode of operation. The main advantage of using an external tank of gas for calibration is that it can provide a sample similar to the actual gas that is to be monitored, which means that, after the monitor has been calibrated, a 1 to 1 reading can be observed on the PPM meter.

The INT REF/EXT REF/ZERO GAS switch on the front panel is set to the EXT REF position during calibration. Sample gas is drawn into the main manifold through zero gas valve V2 by the long stroke pump. It is then forced through the flowmeter and the flowmeter bypass into sample valve V1 and to the calibrating leak assembly. When the gas enters the calibrating leak assembly, bypass valve V3 is actuated and the relief valve operates allowing the gas to exit through the exhaust port. Thus, the sample gas is continually being drawn from the sample area through the monitor and pushed out the exhaust port without entering the DYNA-LOOP.

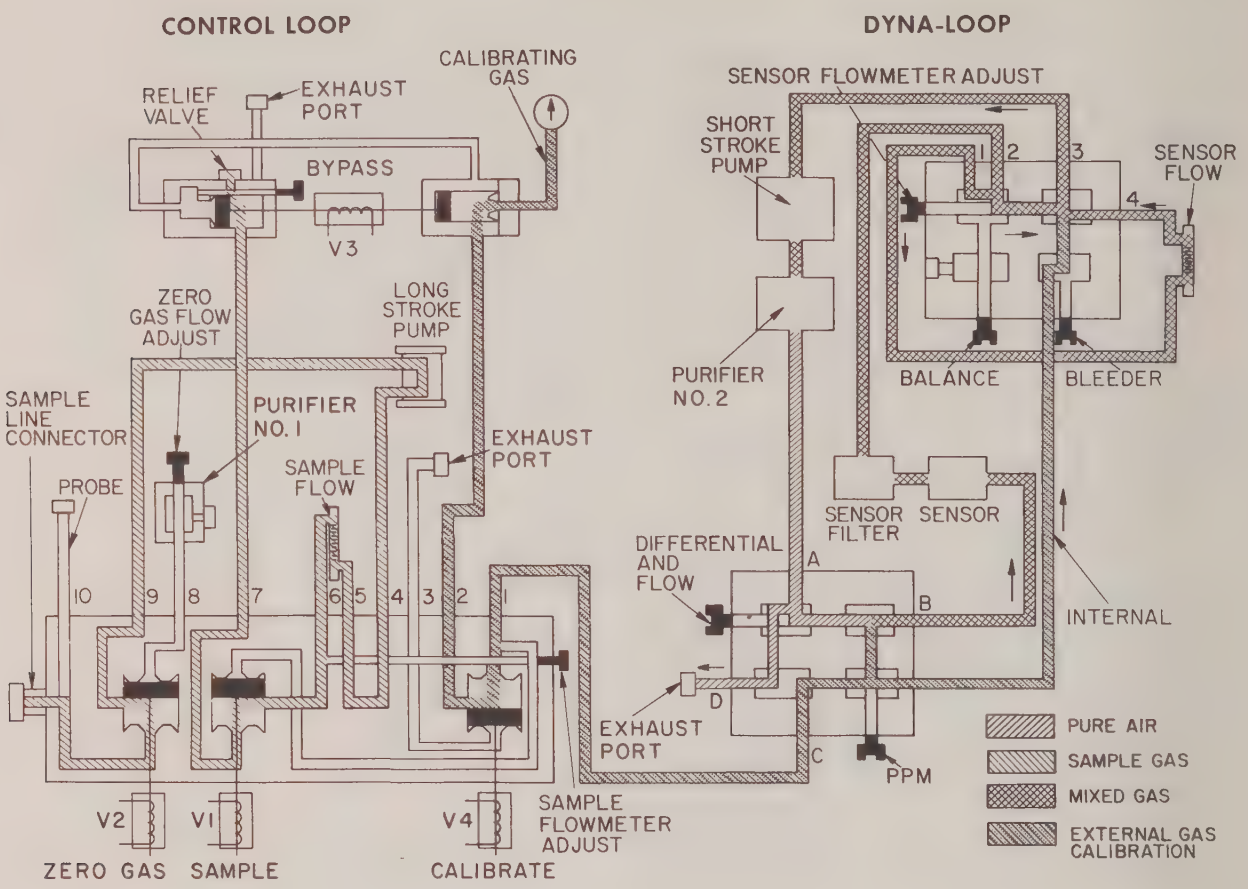


Figure 6-5. Calibration With External Gas Supply

At the same time valve V3 actuates, calibrate valve V4 opens allowing the pressurized calibrating gas to flow through port C of the sample manifold. (For factory style 2 monitors there is a 40 second delay between the actuation of valve V3 and the opening of valve V4.) The calibrating gas now in the DYNA-LOOP, passes through the sensor just the same as in a normal sample sequence during which time the PPM valve can be adjusted to the desired PPM meter indication if the MAN/AUTO switch is in the MAN position. If the switch is in the AUTO position the PPM indication will not appear until the end of the sample cycle.

The main manifold controls the sequence of sample vs calibration gas passed to the DYNA-LOOP. Because the sensor does not distinguish between the gases, it operates in a normal sample sequence.

6.4.4 Zero Gas Sequence

Figure 6-6 depicts the zero gas sequence mode of operation, which is employed primarily to ensure the purifiers have not been contaminated through use. Pure air enters purifier number 1 and flows through zero gas valve V2 in the main manifold, through the pump and flowmeter to sample valve V1, and into the DYNA-LOOP. When the INT REF/EXT REF/ZERO GAS switch on the front panel is held in the ZERO GAS position, the DYNA-LOOP acts in a normal sample mode of operation and provides an indication on the PPM meter if a halogen contaminent remains in the system.

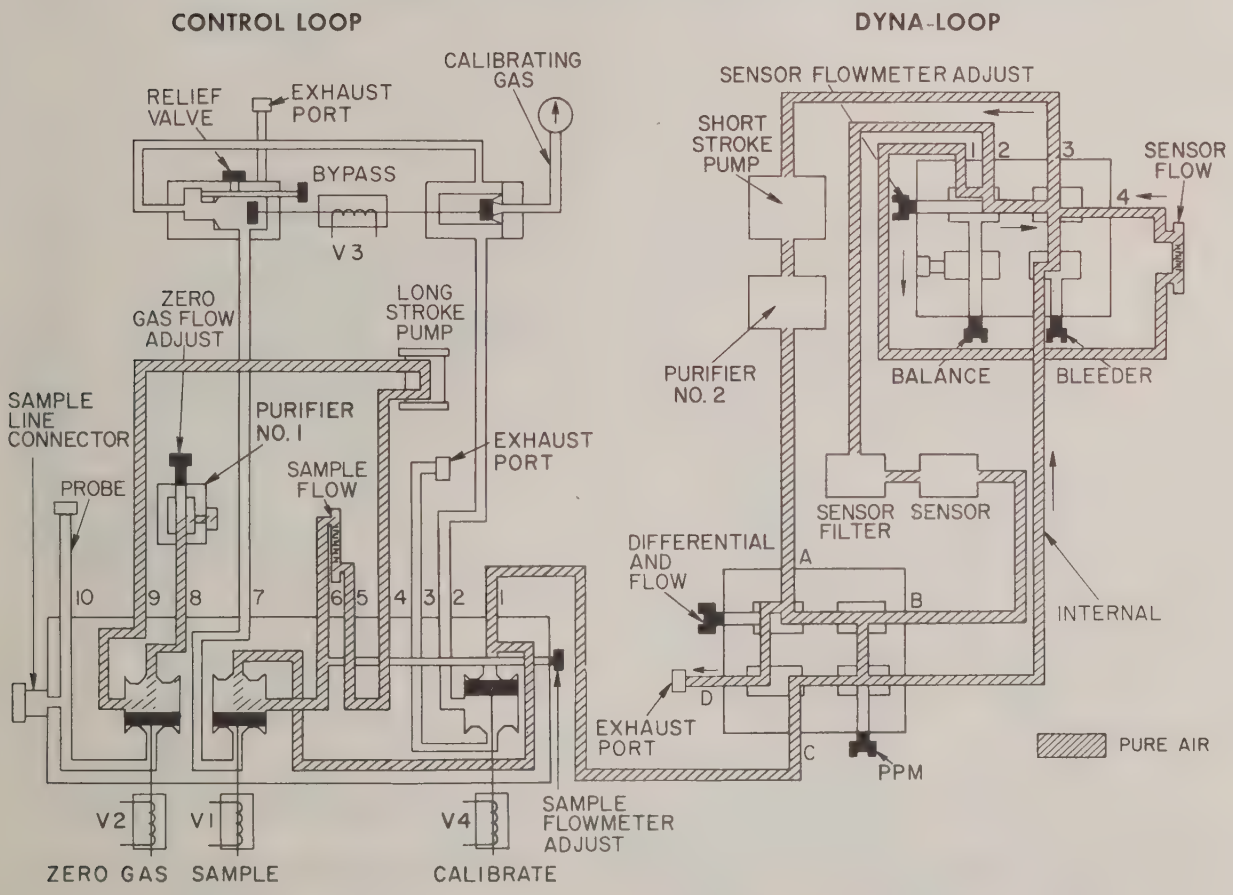


Figure 6-6. Zero Gas Sequence

6.4.5 Calibration With Internal Gas Supply

Figure 6-7 shows the calibration with internal gas supply mode of operation. When an internal calibration leak capsule is inserted into the monitor, in place of the external gas connection, two changes must be made. First, the green bypass valve V3 on the standard calibrating leak assembly must be opened about 1¼ to 1½ turns and the INT REF/EXT REF/ZERO GAS switch on the front panel set to the INT REF position.

When using the internal calibrating leak capsule, the zero gas purifier becomes part of the calibration sequence. The sample line input is shutoff by zero gas valve V2 and the zero gas flow valve is adjusted to allow 10 cc/sec of air to be drawn through the zero gas purifier into the main manifold, through the long stroke pump, the flowmeter, and into sample valve V1. It then passes into the standard calibrating leak assembly.

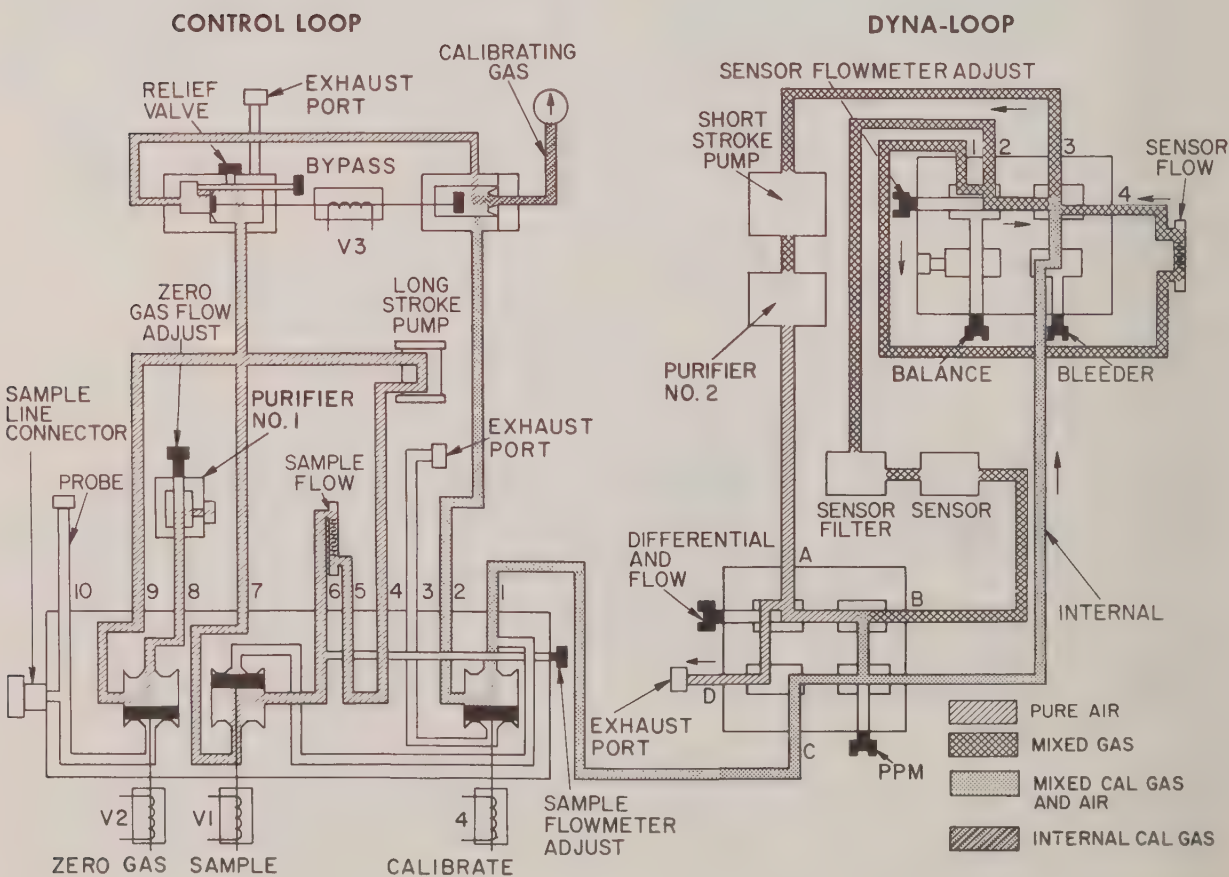


Figure 6-7. Calibration With Internal Gas Supply

With the bypass valve open, the air goes around the seat of the valve into the mixing valve assembly, which is part of the standard calibrating leak assembly. The capsule capillary, being open, allows the capsule to leak R-12 into the system. The capillary provides a known mixture in PPM based on the leak rate of the capsule to the sample manifold. When this mixture enters the DYNA-LOOP through the sample manifold, it is processed the same as an external calibrating gas or an ordinary sample gas sequence to provide an indication on the PPM meter.

6.5 INPUT POWER

Two switches are mounted on the top of the monitor power transformer, one marked HZ 50 and 60, and one marked VOLTS 117 and 234. These will normally be in the 60 HZ, and 117 VOLTS position, The primary windings are in parallel with the switch in the 117 volt position and in series with the switch in the 234 volt position. The 50/60 HZ switch selects a transformer tap that applies either 117 volts for 60 HZ operation or 104 volts for 50 HZ operation of the motor.

SECTION VII

MAINTENANCE

To ensure reliable performance of the monitor, a preventative maintenance schedule should be established based on information contained in this section. Failure to perform scheduled maintenance may cause poor performance, expensive repairs, or voiding of the warranty.

WARNING: IF POWER CORD IS PLUGGED INTO RECEPTACLE, DANGEROUS POTENTIALS EXIST IN CHASSIS EVEN WHEN RANGE SWITCH IS IN OFF POSITION. THEREFORE, REMOVE PLUG FROM POWER SOURCE WHILE PERFORMING PREVENTIVE MAINTENANCE. FAILURE TO REMOVE PLUG MAY RESULT IN ELECTRIC SHOCK CAUSING SERIOUS OR FATAL INJURY.

NOTE: REFER TO TABLE 9-1 FOR MAINTENANCE PARTS.

7.1 PURIFIER AND FILTER REPLACEMENT

NOTE: REPLACE FILTERS AT LEAST EVERY SIXTY DAYS. IF MONITOR IS OPERATED IN A HIGH BACKGROUND HALOGEN ATMOSPHERE, FILTERS MAY HAVE TO BE CHANGED MORE FREQUENTLY.

Perform a zero gas check weekly in accordance with paragraph 4.2.11. If the monitor fails to pass the check replace the zero gas purifier, DYNA-LOOP gas purifier, and sensor filter.

7.1.1 Zero Gas Purifier Replacement

1. Unscrew check valve assembly (2, Figure 3-2) from top of zero gas purifier (1).
2. Unscrew purifier from purifier holder.
3. Install new purifier.
4. Tighten purifier manually.

7.1.2 DYNA-LOOP Gas Purifier Replacement

1. Remove tubing from top check valve assembly (10, Figure 3-2).
2. Unscrew check valve assembly from top of DYNA-LOOP purifier (11).
3. Unscrew purifier from purifier holder.
4. Install new purifier.
5. Tighten purifier manually.

7.1.3 Sensor Filter Replacement

1. Remove case per paragraph 8.2.1, and allow sensor to cool before handling.
2. Locate sensor filter (7, Figure 3-2) and lift straight up.
3. Remove tubing from sensor filter.
4. Install new sensor filter assembly.
5. Replace case.

7.2 SENSOR REPLACEMENT

The sensor does not have a regular replacement schedule inasmuch as the atmosphere in which the monitor is used, the sampling rate, the response of the gas, and other factors affect the life of the sensor. If, after a period of use, a satisfactory emission control setting cannot be achieved (see paragraph 4.2.4) it is likely that the sensor has lost its sensitivity and should be replaced as follows:

> WARNING: ALLOW SENSOR TO COOL BEFORE HANDLING. SENSOR SURFACE TEMPERATURE MAY REACH 212°F (100°C) DURING OPERATION, AND A BURN MAY RESULT IF THE SENSOR IS NOT ALLOWED TO COOL BEFORE TOUCHING.

1. Remove case per paragraph 8.2.1.
2. Remove sensor filter per paragraph 7.1.3.
3. Gently lift (and pry if necessary) sensor (6, Figure 3-2) out of multipronged socket.
4. Align key of new sensor with keyway in sensor socket and press down firmly until it is snugly seated.
5. Replace sensor filter.
6. Replace case.
7. Replace DYNA-LOOP gas purifier per paragraph 7.1.2 as a contaminated purifier may desensitize a new sensor.
8. Recalibrate monitor per paragraph 4.2.

7.3 SAMPLE LINE FILTER REPLACEMENT

Under normal circumstances the sample line filters should be replaced every sixty days or whenever the SAMPLE FLOWmeter indicates the line flow is inhibited. Sample lines located in a moist or extremely dirty area are likely to require more frequent filter replacement.

1. Unscrew cover assembly of filter (17, Figure 3-1).

2. Remove and replace both internal and external filter.

3. Replace cover assembly.

NOTE: PROMPT FILTER REPLACEMENT WILL ENSURE LONG SENSOR LIFE AND GOOD MONITOR PERFORMANCE.

7.4 AIR FILTER CLEANING

1. Every sixty days remove and clean filter (14, Figure 3-2) or replace it with a new one.

2. Use a mild detergent in warm water to clean filter and blow it dry.

7.5 CALIBRATION LEAK CAPSULE RECHARGING

If the desired leak factor cannot be obtained on capsule gage, the calibration leak capsule needs to be recharged:

1. Attach valve and tubing assembly to can of gas.

2. Open valve on can of gas and adjust so that a small amount of gas flows from tube.

3. Insert tube into nipple on side of capsule and then remove 2 or 3 times to purge valve.

4. With tube attached to nipple, turn factor gage about 1/4 turn counterclockwise to bleed gas into capsule and increase pressure.

5. When gage reads desired factor, turn factor gage clockwise to close the bleed, close valve on can of gas, and remove tube.

6. If pressure is too high, turn gage slightly counterclockwise, with tube off, until pressure decreases to desired leak factor, then tighten gage.

Table 8-1. TVM-1 Monitor Troubleshooting Chart (Cont.)

TROUBLE	PROBABLE CAUSE	SUGGESTED REMEDY
PPM meter does not pass through phases of indication as per paragraph 4.2.6 after MANUAL CALIBRATE pushbutton is pressed.	1. Monitor not correctly calibrated.	1. Recalibrate monitor per paragraph 4.2.
	2. Empty external calibration tank of gas.	2. Replace calibration tank of gas per paragraph 4.1.2.
	3. Low charge on internal calibration leak capsule.	3. Recharge calibration leak capsule per paragraph 7.5.
	4. Broken or leaking tubing.	4. Replace tubing per paragraph 8.2.3.
	5. INT REF/EXT REF/ ZERO GAS switch in wrong position.	5. Check setting of INT REF/ EXT REF/ZERO GAS switch.
	6. Faulty alarm and logic printed circuit board.	6.* Replace alarm and logic printed circuit board per paragraph 8.2.6.
	7. Faulty amplifier printed circuit board.	7.* Replace amplifier printed circuit board per paragraph 8.2.7 and reset zero per paragraph 8.1.1.
	8. Faulty power supply and sensor printed circuit board.	8.* Replace power supply and sensor printed circuit board per paragraph 8.2.8 and reset zero per paragraph 8.1.1.
	9. Contaminated zero gas purifier No.1.	9. Replace zero gas purifier per paragraph 7.1.1.
	10. Contaminated sample gas purifier No.2.	10. Replace sample gas purifier per paragraph 7.1.2.
	11. Contaminated sensor filter.	11. Replace sensor filter per paragraph 7.1.3.
	12. Faulty sensor.	12. Replace sensor per paragraph 7.2.
	13. Faulty PPM meter.	13. Replace PPM meter.
PPM meter does not read zero when ZERO GAS check is made per paragraph 4.2.11.	1. Contamined purifier.	1. Replace zero gas purifier per paragraph 7.1.1 and sample gas purifier per paragraph 7.1.2.

*Before replacing a printed circuit board, check that correct dc voltages are supplied to the board per paragraph 8.1.4.

Table 8-1. TVM-1 Monitor Troubleshooting Chart (Cont.)

TROUBLE	PROBABLE CAUSE	SUGGESTED REMEDY
Front panel lamps do not light at appropriate time during monitor calibration per paragraph 4.2.	1. Panel lamp burned out.	1. Replace panel lamp.
Speaker does not sound during audio alarm setting per paragraph 4.2.9.	1. Faulty speaker.	1. Replace speaker per paragraph 8.2.5.
	2. Faulty alarm and logic printed circuit board.	2.* Replace alarm and logic printed circuit board per paragraph 8.2.6.
SAMPLE ALARM lamp does not flash during video alarm setting per paragraph 4.2.9.	1. Faulty alarm and logic printed circuit board.	1.* Replace alarm and logic printed circuit board per paragraph 8.2.6.
Remote alarm indicators do not function.	1. Faulty electrical hookup.	1. Check wiring connections per Figures 4-1 and 4-2.
	2. Blown 3/8 amp fuse.	2. Replace fuse.
	3. Faulty auxiliary relay unit.	3. Replace auxiliary relay unit.
PPM meter reading drifts.	1. Faulty amplifier printed circuit board.	1.* Replace amplifier printed circuit board per paragraph 8.2.7 and reset zero per paragraph 8.1.1.
SAMPLE lamp does not light 4-14 minutes after MANUAL CALIBRATE pushbutton is pressed.	1. SAMPLE lamp burned out.	1. Replace SAMPLE lamp.
	2. Faulty amplifier printed circuit board.	2.* Replace amplifier printed circuit board per paragraph 8.2.7 and reset zero per paragraph 8.1.1.
CALIBRATE lamp does not light when MANUAL CALIBRATE pushbutton is pressed.	1. CALIBRATE lamp burned out.	1. Replace CALIBRATE lamp.
	2. Faulty alarm and logic printed circuit board.	2. Replace alarm and logic printed circuit board per paragraph 8.2.6.

*Before replacing a printed circuit board, check that correct dc voltages are supplied to the board per paragraph 8.1.4.

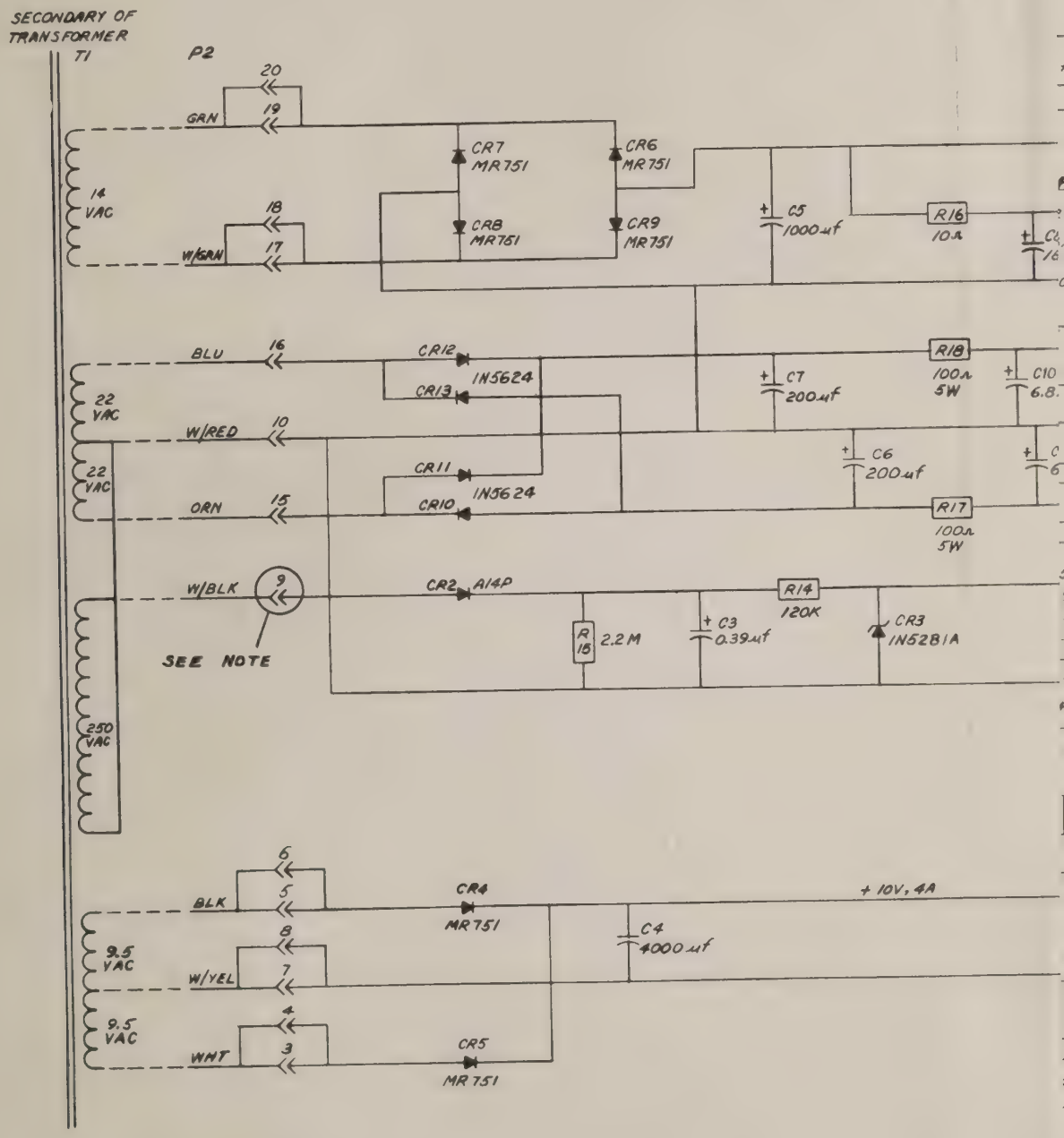
Table 8-1. TVM-1 Monitor Troubleshooting Chart (Cont.)

TROUBLE	PROBABLE CAUSE	SUGGESTED REMEDY
CALIBRATE ALARM lamp does not flash during calibrate alarm setting per paragraph 4.2.13.	1. CALIBRATE ALARM lamp burned out.	1. Replace CALIBRATE ALARM lamp.
	2. Faulty alarm and logic printed circuit board.	2.* Replace alarm and logic printed circuit board per paragraph 8.2.6.
PPM meter does not read approximately 0.5 on top linear 0-10 scale during emission setting per paragraph 4.2.4.	1. Emission control not properly set.	1. Adjust emission control per paragraph 4.2.4.
	2. Faulty sensor.	2. Replace sensor per paragraph 7.2.
	3. Faulty power supply and sensor printed circuit board.	3.* Replace power supply and sensor printed circuit board per paragraph 8.2.8 and reset zero per paragraph 8.1.1.
	4. Faulty amplifier printed circuit board.	4.* Replace amplifier printed circuit board per paragraph 8.2.7 and reset zero per paragraph 8.1.1.
Monitor is operating warmer than normal.	1. Clogged air filter.	1. Clean or replace air filter per paragraph 7.4.
	2. Faulty fan motor.	2. Replace fan motor.

*Before replacing a printed circuit board, check that correct dc voltages are supplied to the board per paragraph 8.1.4.

Figures 8-1, 8-2, and 8-3 are detailed schematics of the three printed circuit boards that are used in the monitor. If a suspected fault lies within a circuit function contained on one of these boards, reference should be made to paragraph 8.2 for removal and replacement procedures for that particular board as each has its unique procedure. It is recommended that faulty boards be replaced and that no attempt be made to repair individual boards.

Figure 8-4 illustrates the layout of the wiring harness assembly within the monitor. It may be used as an aid in performing a continuity check when searching for an open, shorted, or intermittent circuit. Figure 8-8 together with Table 8-2 present pneumatic tubing run information for use when replacing cracked or worn tubing.



NOTE: ON LATER MODELS THIS PIN IS TERMINAL 1.

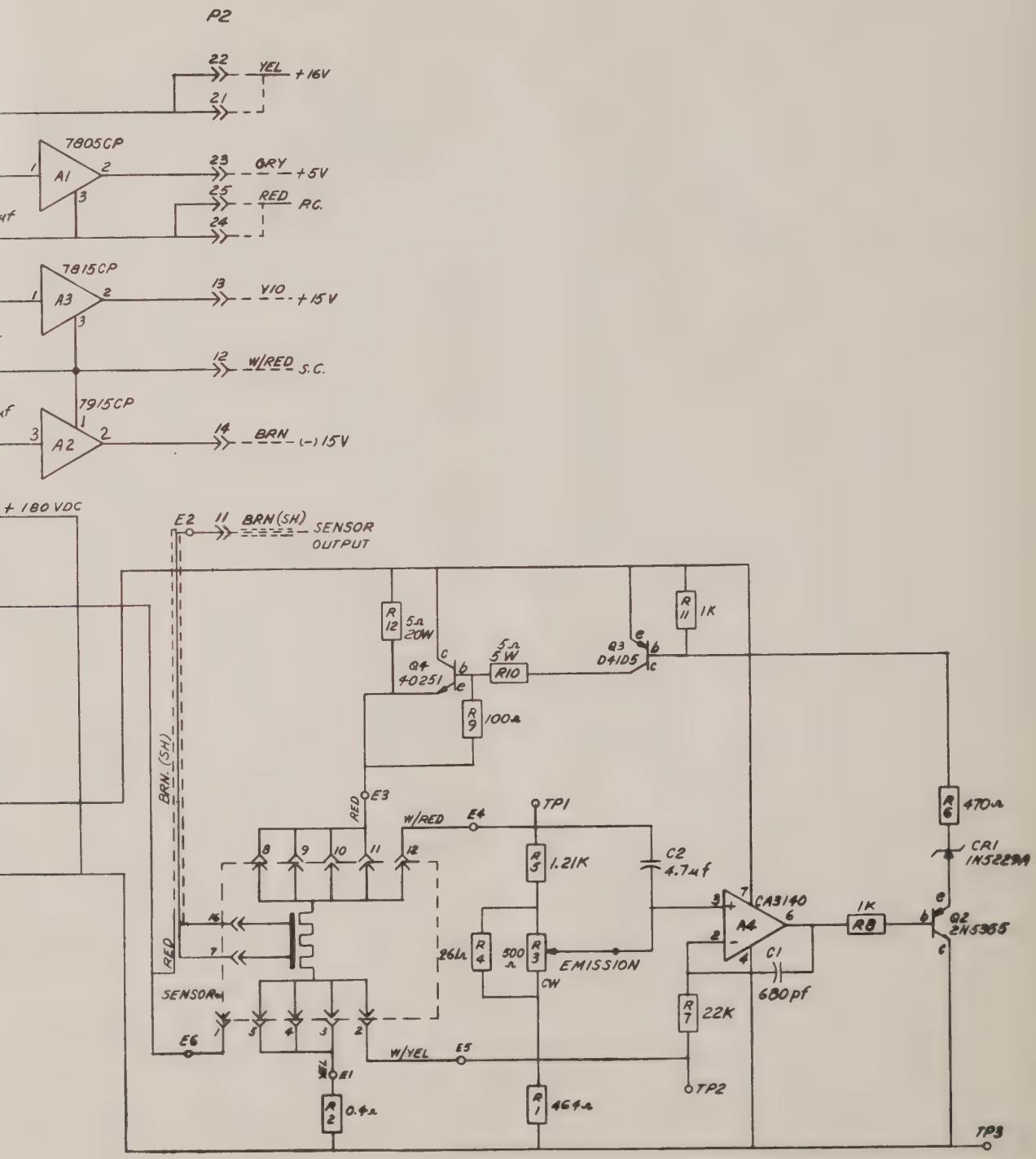
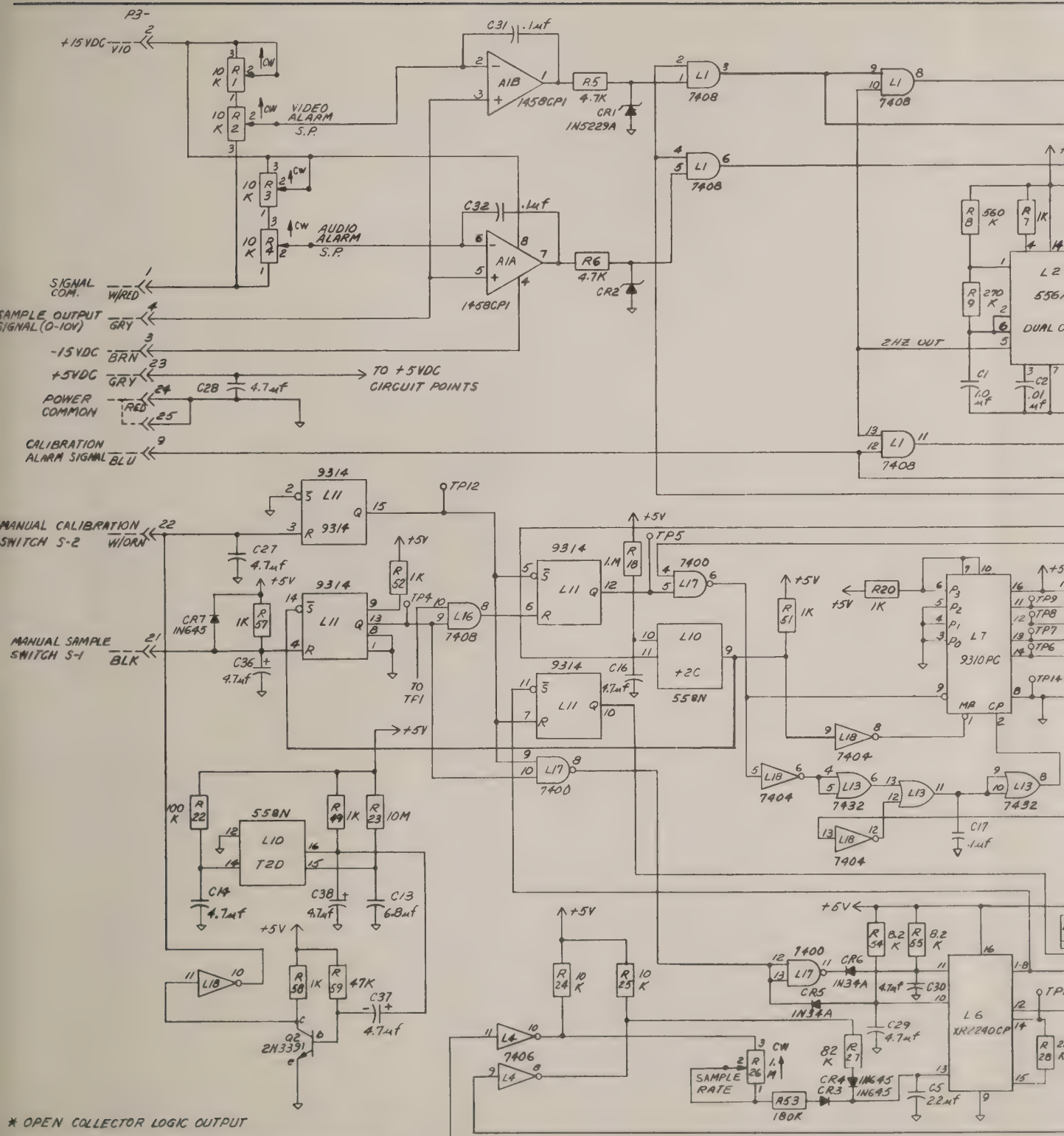


Figure 8-1. Power Supply and Sensor Printed Circuit Board Schematic Diagram



* OPEN COLLECTOR LOGIC OUTPUT

1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE NOTED
2. ALL 14 PIN PACKAGES Vcc = PIN 14, GND = PIN 7
   ALL 16 PIN PACKAGES VCC = PIN 16 GND = PIN 8
   ALL OTHER PACKAGES VCC AND GND ARE NOTED

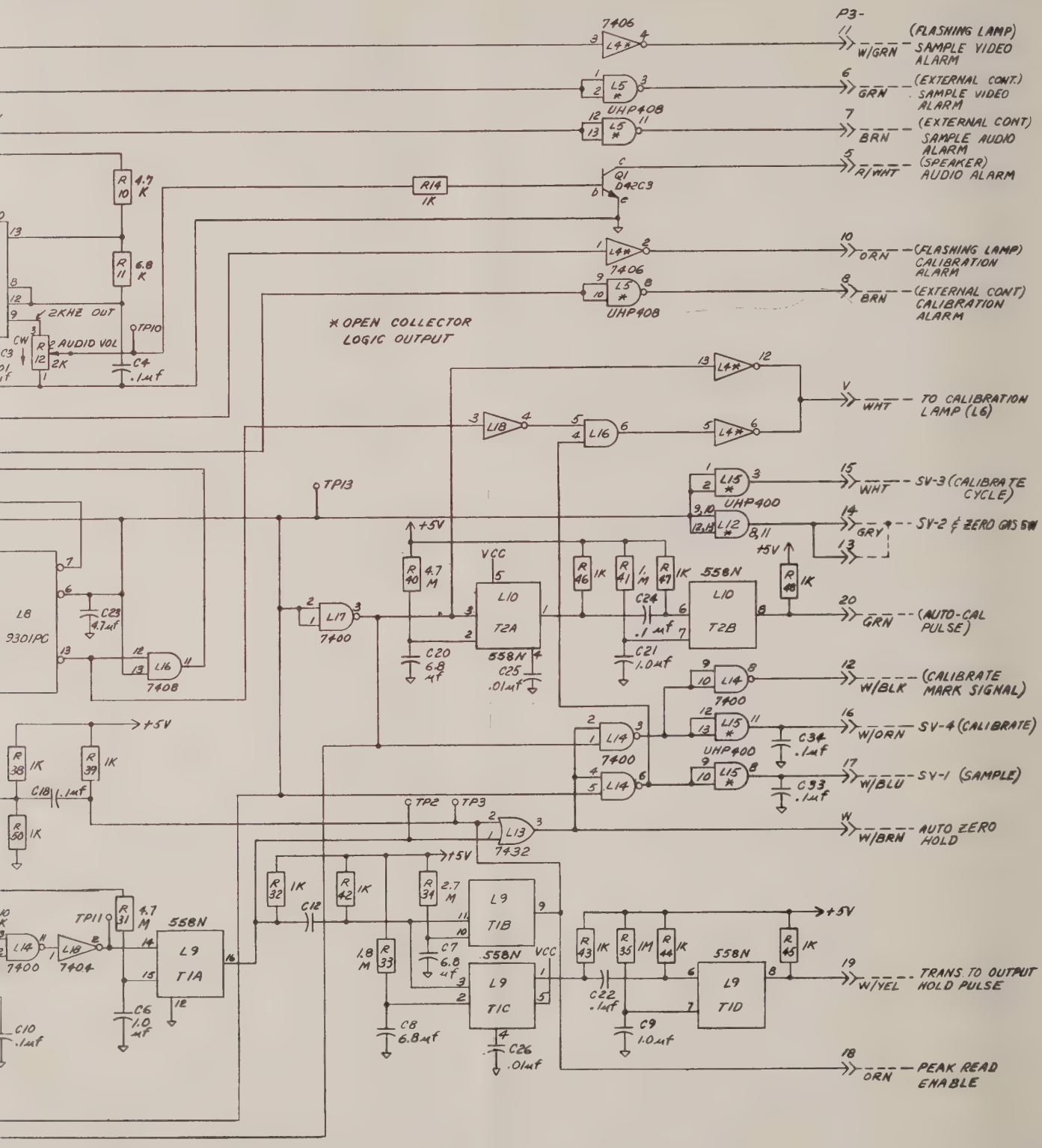
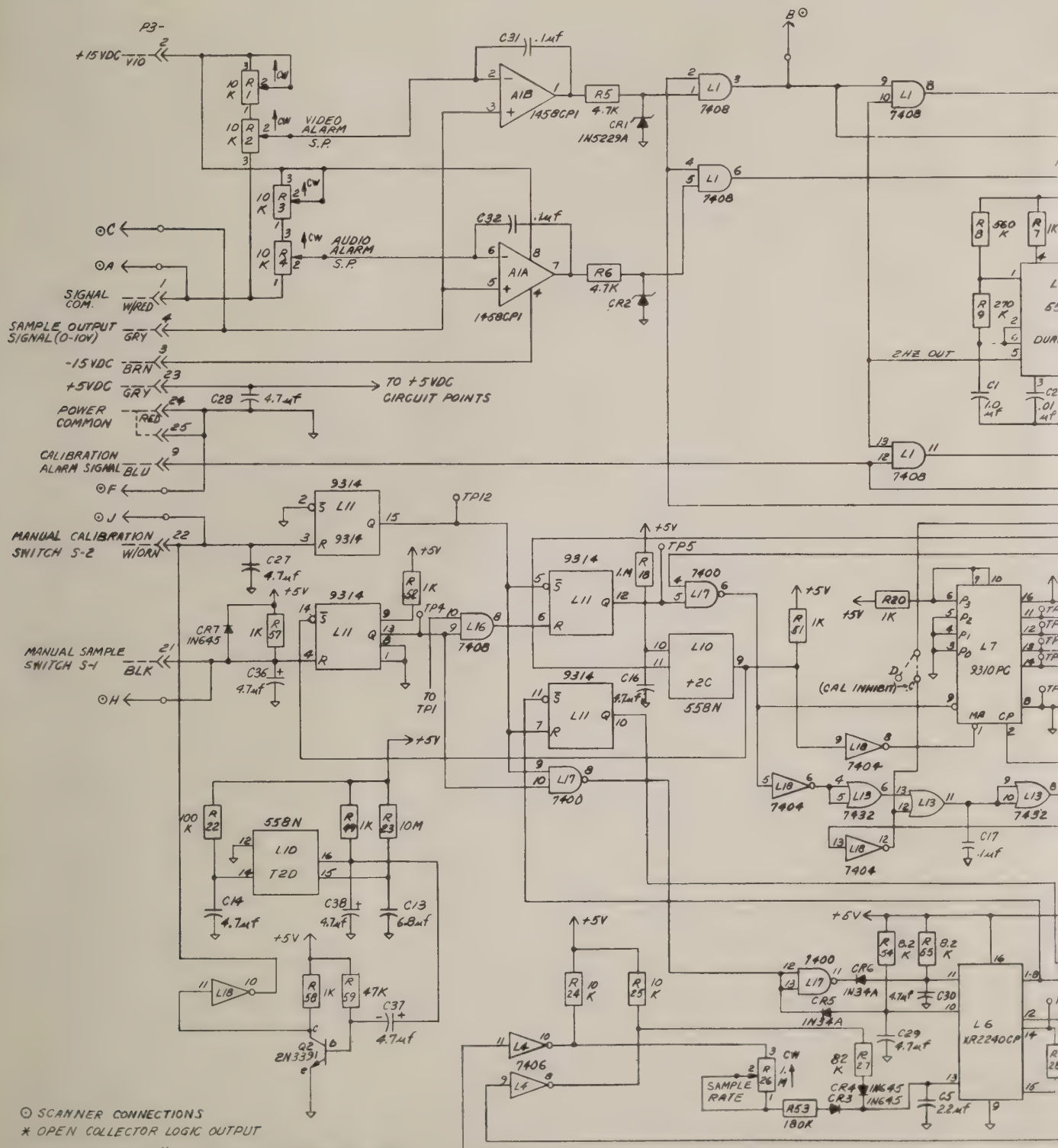


Figure 8-2. Alarm and Logic Printed Circuit Board Schematic Diagram (Sheet 1 of 2)


P3-
+15VDC
VIO
10K R1
10K R2
CW
VIDEO ALARM S.P.
C31 .1μf
A1B
1458CP1
R5 4.7K
CR1 IN5229A
L1 7408
B⊙
10K R3
10K R4
AUDIO ALARM S.P.
C32 .1μf
A1A
1458CP1
R6 4.7K
CR2
⊙C
⊙A
SIGNAL COM. WIRED
SAMPLE OUTPUT SIGNAL(0-10V) GRY
-15VDC BRN
+5VDC GRY
POWER COMMON RED
C28 4.7μf
TO +5VDC CIRCUIT POINTS
CALIBRATION ALARM SIGNAL BLU
⊙F
⊙J
MANUAL CALIBRATION SWITCH S-2 WHORN
⊙H
MANUAL SAMPLE SWITCH S-1 BLK
C27 4.7μf
C36 4.7μf
CR7 IN645
9314 L11
R57 1K
R58 1K
TP12
TP4
TP5
TO TP1
L16 7408
L17 7400
L10 +2C 558N
R18 1M
R51 1K
R20 1K
(CAL INHIBIT)
L7 9310PC
L18 7404
L13 7432
C17 .1μf
558N L10 T2D
R22 100K
R23 10M
C14 4.7μf
C38 4.7μf
C13 6.8μf
R58 1K
R59 47K
C37 4.7μf
Q2 2N3331
R24 10K
R25 10K
L4 7406
R54 8.2K
R55 8.2K
CR5 IN34A
CR6 IN34A
C30 4.7μf
C29 4.7μf
L6 XR2240CP
SAMPLE RATE
R26 1M CW
R27 82K
CR3 IN645
CR4 IN645
R53 180R
C5 2.2μf
R8 560K
R7 1K
R9 270K
2HZ OUT
C1 1.0μf
C2 .01μf
⊙ SCANNER CONNECTIONS
* OPEN COLLECTOR LOGIC OUTPUT
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE NOTED
2. ALL 14 PIN PACKAGES Vcc = PIN 14, GND = PIN 7
ALL 16 PIN PACKAGES Vcc = PIN 16 GND = PIN 8
ALL OTHER PACKAGES Vcc AND GND ARE NOTED

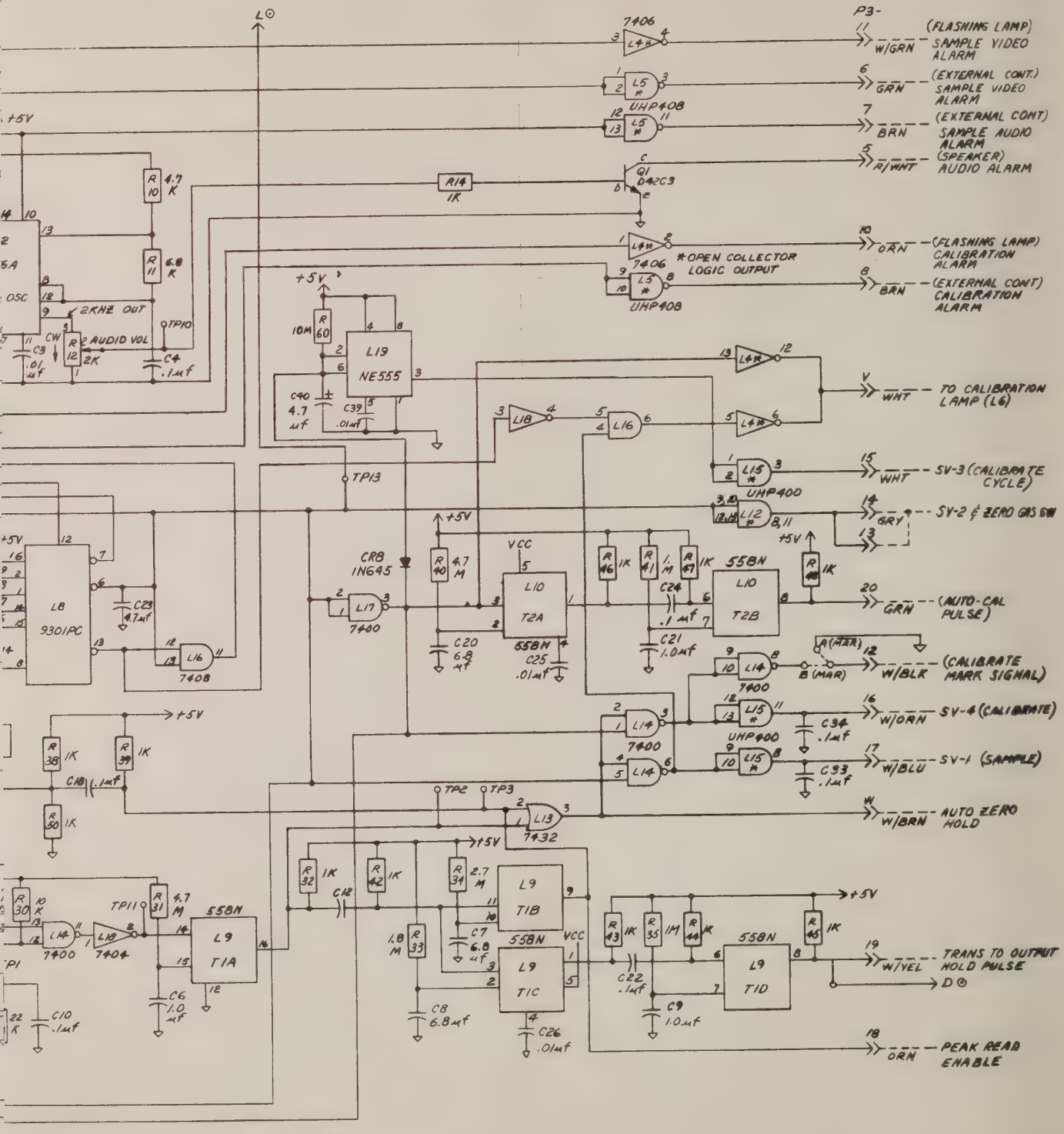
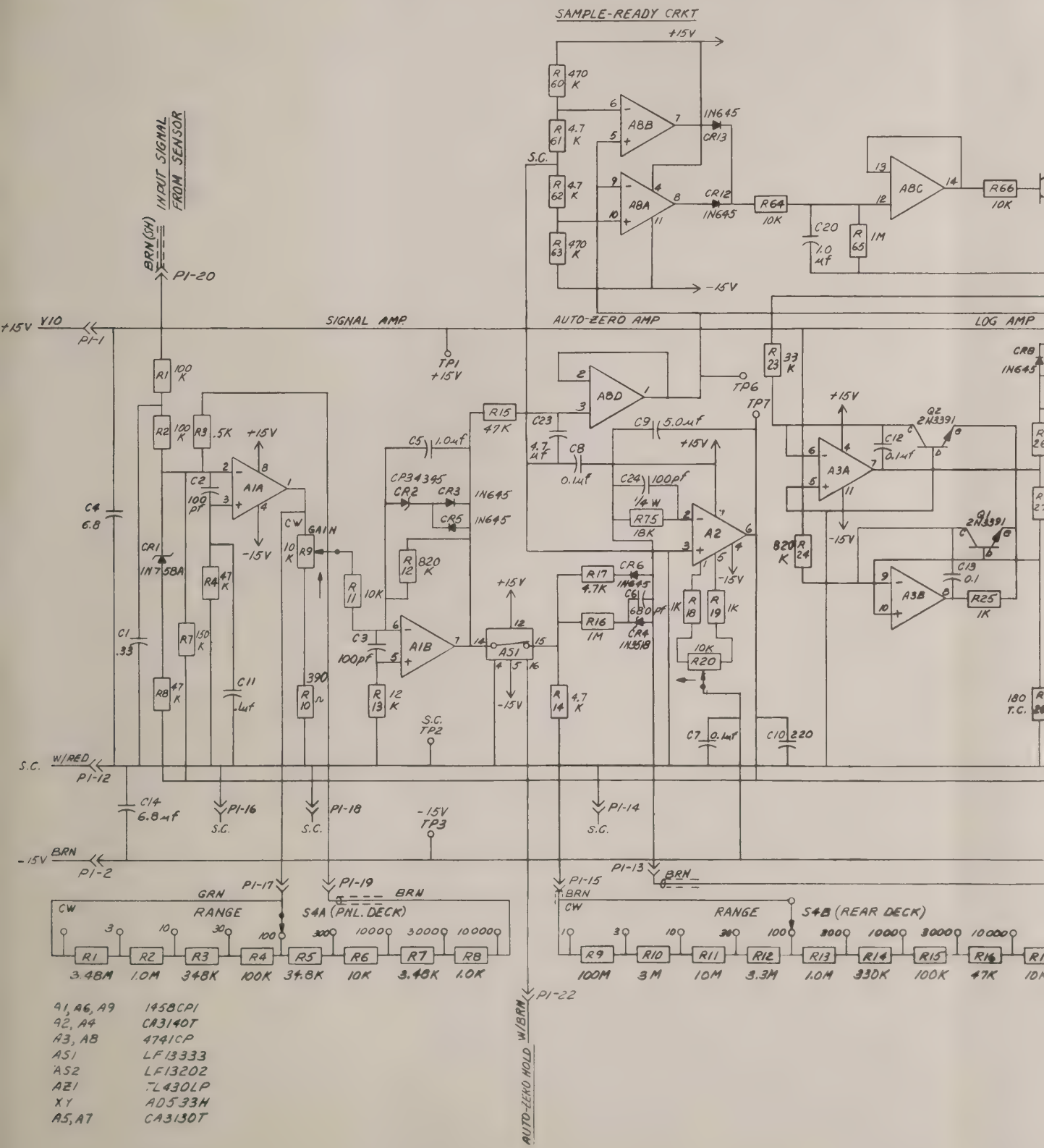


Figure 8-2. Alarm and Logic Printed Circuit Board Schematic Diagram (Sheet 2 of 2)



A1, A6, A9	1458CPI
A2, A4	CA3140T
A3, A8	4741CP
AS1	LF13333
AS2	LF13202
AZ1	TL430LP
XY	AD533H
A5, A7	CA3130T

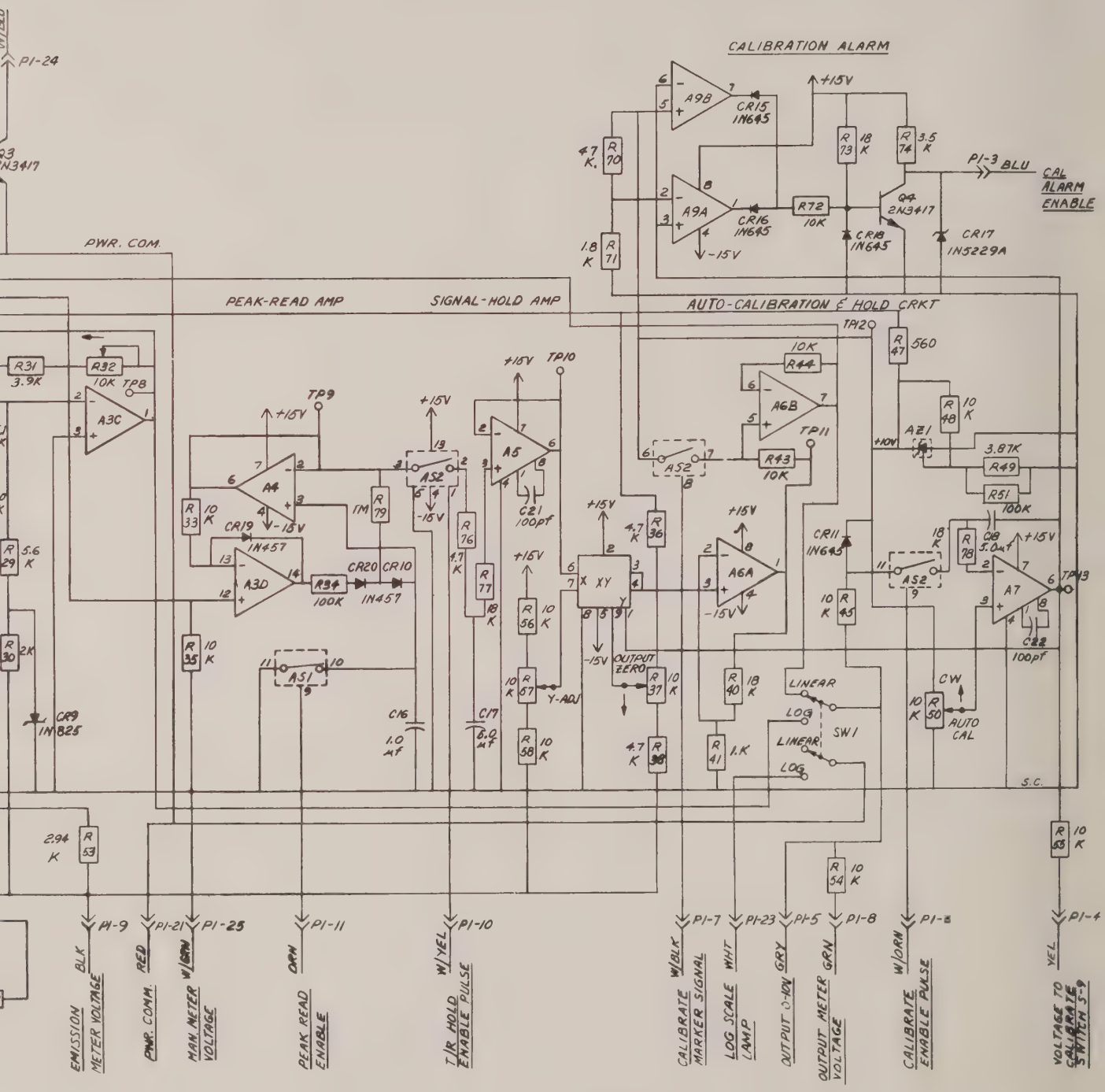


Figure 8-3. Amplifier Printed Circuit Board Schematic Diagram

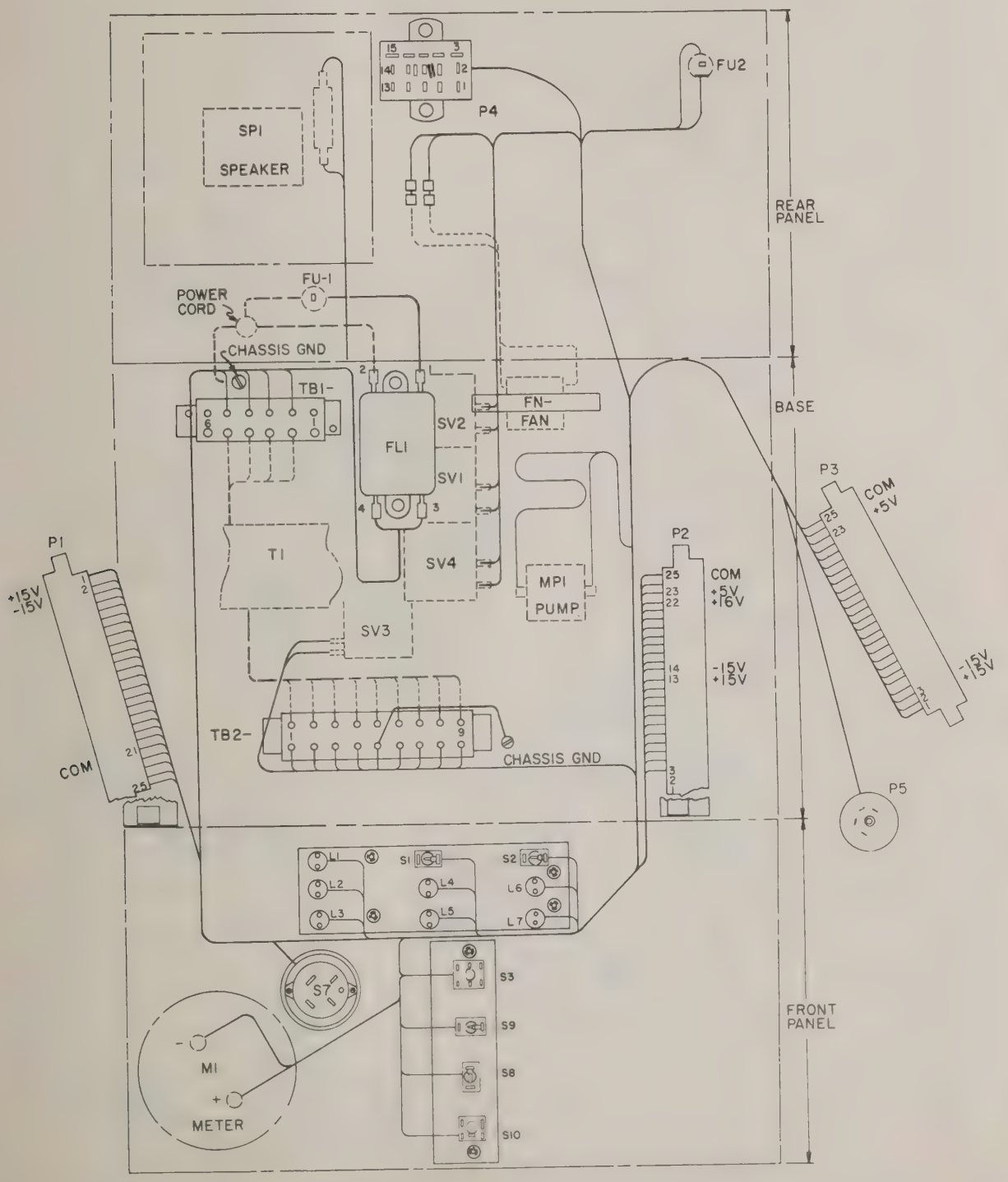


Figure 8-4. Wiring Harness Assembly

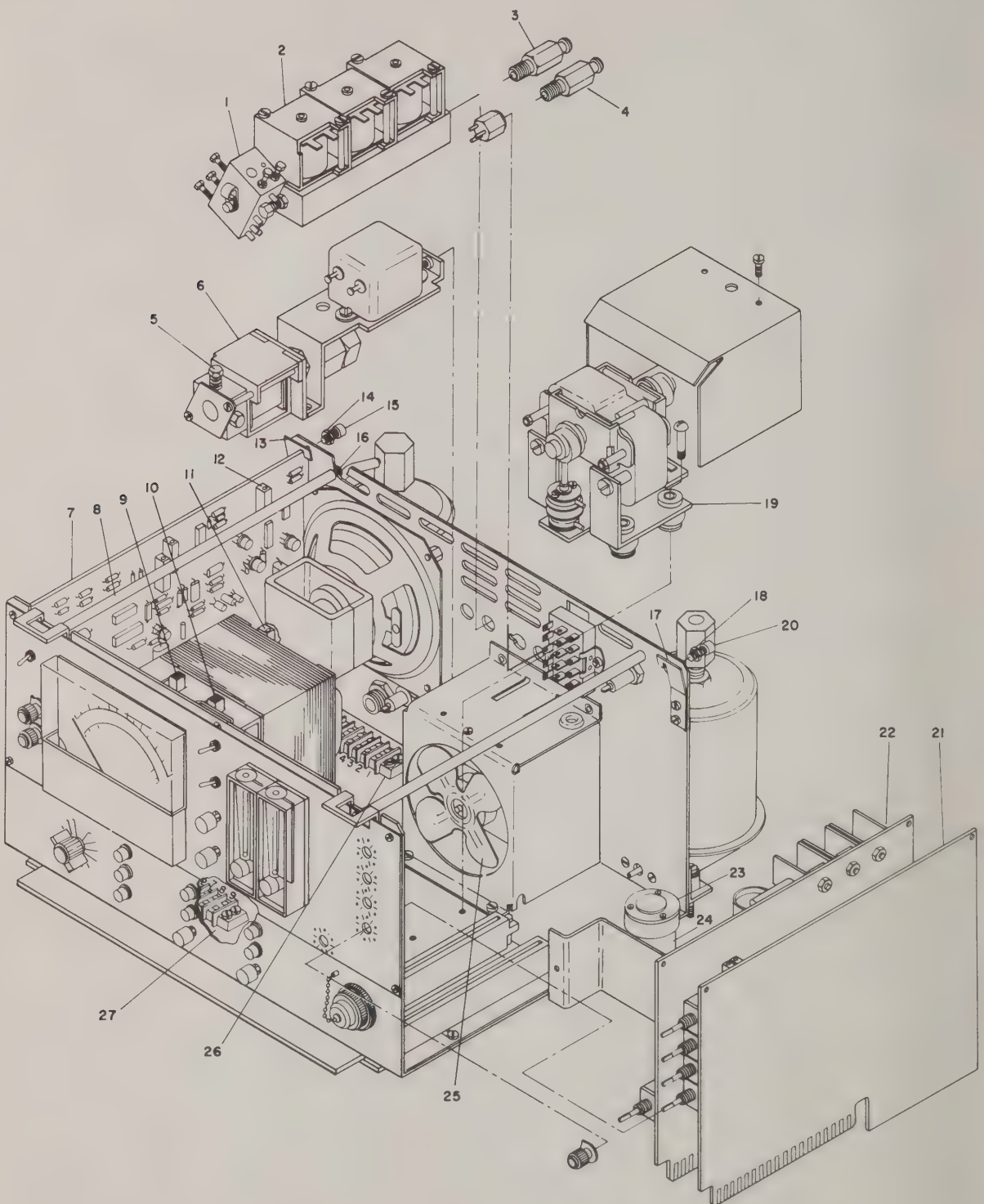


Figure 8-5. Monitor Disassembly

LEGEND FOR FIGURE 8-5

1. Sample Manifold Assembly*
2. Valve Assembly*
3. Coupler*
4. Exhaust Port*
5. Bypass Valve
6. Calibrating Leak Assembly*
7. Amplifier Printed Circuit Board Assembly*
8. Rod
9. HZ Switch
10. VOLTS Switch
11. R57 Trimpot
12. R37 Trimpot
13. Clip
14. Thin Nut
15. Screw
16. Screw
17. Clip
18. Thin Nut
19. Pump and Motor Assembly*
20. Screw
21. Logic and Alarm Printed Circuit Board*
22. Power Supply and Sensor Printed Circuit Board*
23. Sensor Filter*
24. Sensor*
25. Fan Motor Assembly*
26. Terminal Board 1
27. Terminal Board 2

*Replaceable Parts

8.1.1 ZERO CHECK

1. Install new purifiers and sensor filter in monitor per paragraphs 7.1.1, 7.1.2, and 7.1.3.
2. Turn SAMPLE RATE control (18, Figure 4-3) to full counterclockwise position.
3. Press MANUAL CALIBRATE pushbutton (14) and wait three minutes.
4. Press MANUAL SAMPLE pushbutton (11).
5. Observe NOT READY lamp (7) extinguishes.
6. Press and hold INT REF/EXT REF/ZERO GAS switch (23) down in ZERO GAS position until step 10 is reached.
7. Press MANUAL SAMPLE pushbutton.
8. When SAMPLE lamp (10) extinguishes, press MANUAL SAMPLE pushbutton again.

9. Repeat step 8 once more for a total of three sample times.

10. Release INT REF/EXT REF/ZERO GAS switch (23).

11. Rotate AUTO CAL control (2) to full counterclockwise position and observe PPM meter (26) indicates zero.

12. If PPM meter does not indicate zero, remove case per paragraph 8.2.1.

13. Adjust R37 (12, Figure 8-5) until PPM meter indicates zero.

14. Turn AUTO CAL control to full clockwise position and observe PPM still indicating zero.

15. If PPM meter does not indicate zero, adjust R57 (11, Figure 8-5) until PPM meter does indicate zero.

16. Turn AUTO CAL control to full counterclockwise position and observe that PPM meter pointer does not move.

17. If PPM meter pointer moves, adjust AUTO CAL control until PPM meter indicates calibration gas level.

18. Repeat steps 3 through 17 until PPM meter pointer does not move.

19. Replace case.

8.1.2 Pump Check

If pump is not operating correctly, check for:

1. Cracks in bellows

2. Epoxy leaks

3. Check and remove dirt in valves or passageways

4. Proper stroke length (cracks in epoxy indicate push rod has moved)

5. Motor speed. Motor is synchronous and will vibrate if operating out of speed.

8.1.3 Sampling Manifold Valve Adjustments

NOTE: SAMPLING MANIFOLD VALVE ADJUSTMENTS MUST BE MADE WHENEVER THE PUMP IS REPLACED.

8.1.3.1 Differential and Flow Valve

1. Connect air flow gage between port A and exhaust side of pressure pump (see Figure 8-6).

2. Connect suction (top port) side of pressure pump to port 3.

3. Completely close (clockwise), PPM and bleeder valves.

4. Open sample flowmeter valve about two turns counterclockwise.

5. Adjust differential and flow valve until air flow gage installed in step 1 indicates 4 $\pm$ 0.5 cc/sec.

8.1.3.2 Bleeder Valve

1. Open bleeder valve counterclockwise until air flow gage increases 1 $\pm$ 0.1 cc/sec from 4 $\pm$ 0.5 cc/sec.

8.1.3.3 PPM Valve

1. Open PPM valve counterclockwise until air flow gage increases a pointers width.

2. Remove air flow gage and reconnect pressure pump.

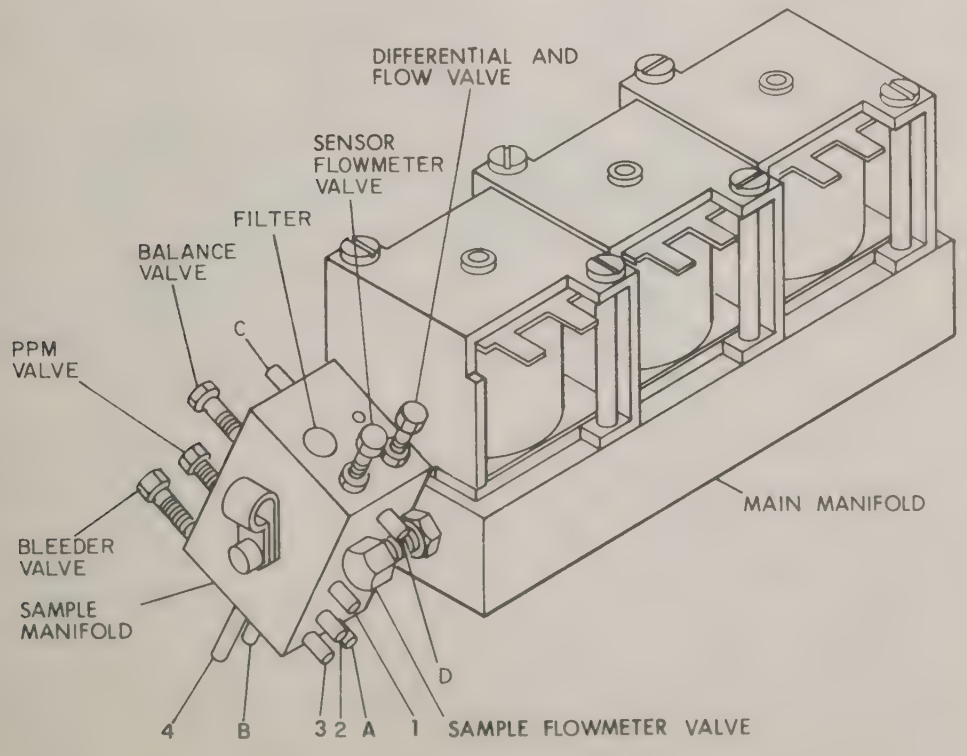


Figure 8-6. Manifold Valve Locations

8.1.4 Printed Circuit Board DC Supply Voltage Check

1. Remove case per paragraph 8.2.1.
2. With a voltmeter make the following voltage checks (see Figure 8-4):

Amplifier Printed Circuit Board (P1)

Pins	DC Volts
P1-21	Common
P1-1	+15
P1-2	-15

Power Supply and Sensor Printed Circuit Board (P2)

Pins	DC Volts
P2-25	Common
P2-23	+5
P2-22	+16
P2-14	-15
P2-13	+15

Alarm and Logic Printed Circuit Board (P3)

Pins	DC Volts
P3-25	Common
P3-23	+5
P3-3	-15
P3-2	+15

3. Replace case.

8.1.5 Power Transformer Check

1. Remove case per paragraph 8.2.1.
2. Check that HZ switch (9, Figure 8-5) is in 60 position and VOLTS switch (10) is in 117 position.
3. Apply 117 volts, 60 Hz to TB1 terminals 4 and 5 (see Figure 8-7).
4. Measure with a voltmeter:

Terminals	AC Volts
TB1 2 and 5	117 ± 5%
TB1 3 and 5	117 ± 5%
TB2 1 and 2	9.5 ± 5%
TB2 2 and 3	9.5 ± 5%
TB2 4 and 5	250 ± 5%
TB2 6 and 7	14 ± 5%
TB2 8 and 9	44 ± 5%

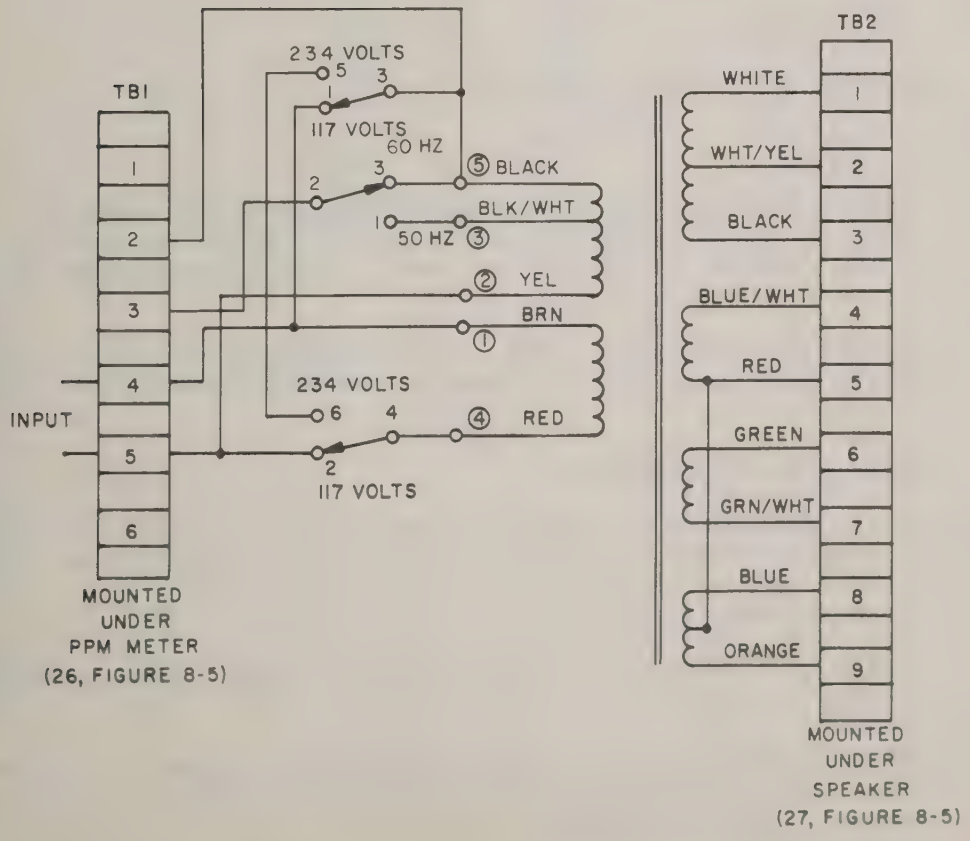


Figure 8-7. Power Transformer Schematic Diagram

5. Slide HZ switch to 50 position and measure TB1 terminals 3 and 5 for 104 volts ± 5%.

6. Slide VOLTS switch to 234 position, apply 117 volts to TB1 terminals 4 and 5.

7. Measure following points to check switch wiring:

Terminals	AC Volts
TB1 4 and 5	117 ± 10%
TB1 2 and 5	58.5 ± 10%
TB1 3 and 5	52.0 ± 10%
TB2 1 and 2	5.0 ± 10%
TB2 2 and 3	5.0 ± 10%
TB2 4 and 5	125 ± 5%
TB2 6 and 7	7.0 ± 10%
TB2 8 and 9	22 ± 5%

8. Slide HZ switch back to 60 position and measure TB1 terminals 3 and 5 for 58.5 volts ± 5%.

9. Slide VOLTS switch back to 117 position.

10. Replace case.

8.2 REMOVAL AND REPLACEMENT PROCEDURES

8.2.1 Case Removal

The case (23, Figure 3-1) is a wrap-around type which is secured to the chassis at the front by a plate and at the rear by two captive screws. To remove the case, loosen the two captive screws; then slide the case off the chassis toward the front.

To install the case, slide it onto the chassis from the front until the captive screws align with the clinch nuts in the case assembly. Tighten the captive screws.

8.2.2 Hinged Front-Cover Removal

After the case has been removed per paragraph 8.2.1, the hinged front cover (22, Figure 3-1) can be removed for troubleshooting and repair procedures.

1. Loosen locking screw (21).

2. Swing cover out from bottom and up to disengage hook-and-loop hinges at top of cover.

3. After calibration and/or repair procedures are complete, replace cover by engaging hooks in loops, swing cover down, and lock in place by tightening locking screw.

8.2.3 Tubing Replacement

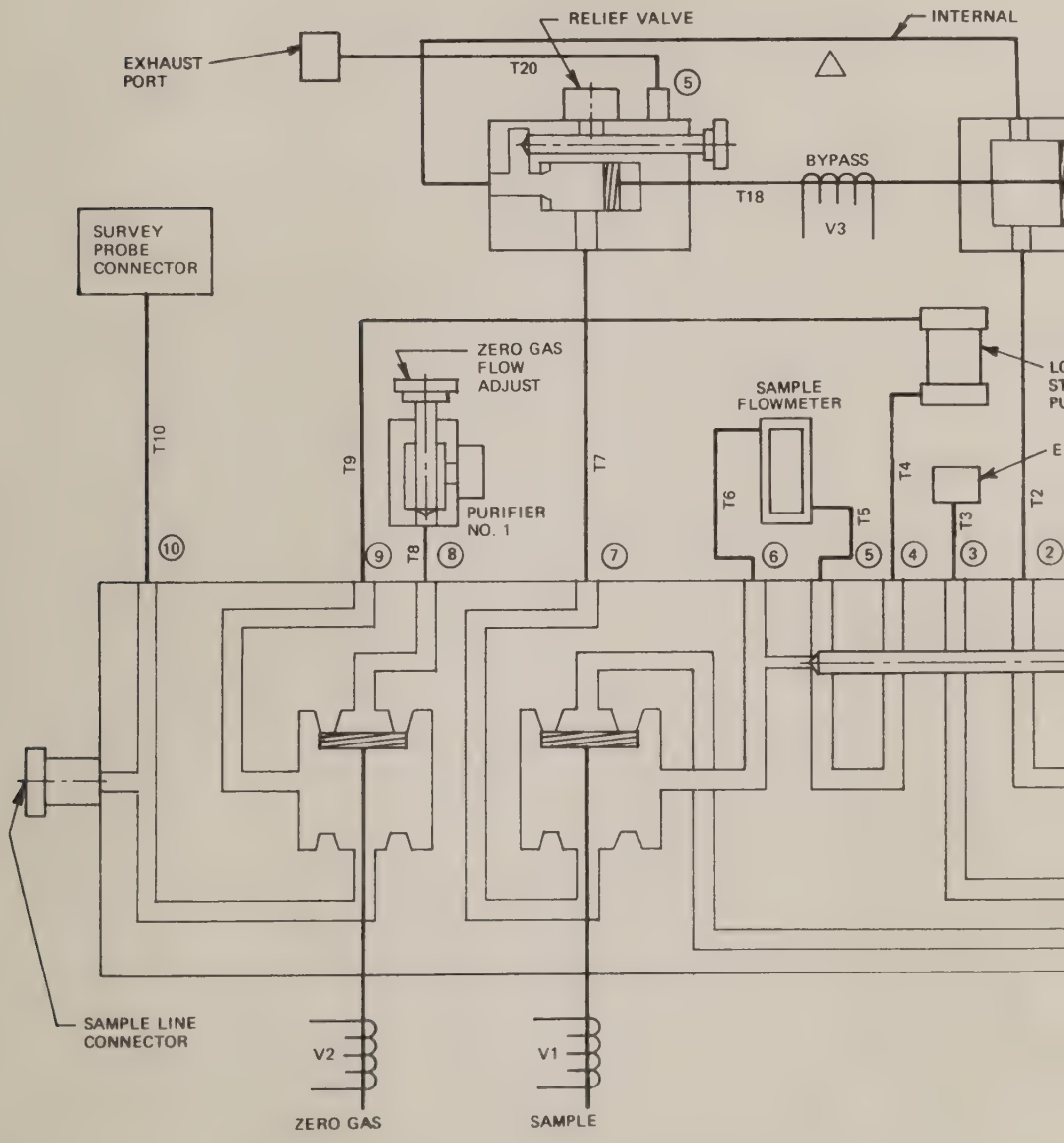
If the tubing within the chassis has to be replaced, the proper lengths should be maintained as per Table 8-2 and Figure 8-8.

Table 8-2. Tubing Connections

Tube No. (Fig. 8-8)	From	To	Length (Inches)
1	MM 1	C	6.5
2	MM 2	SCL-4	9
3	MM 3	EXP	13
4	MM 4	LSP-2	19
5	MM 5	FM #1-2	11.5
6	MM 6	FM #1-1	12.5
7	MM 7	SCL-1	10.5
8	MM 8	PUR #1-1	16
9	MM 9	LSP-1	17
10	MM 10	RP-1	23
11	SM A	PUR #2-1	14
12	SM B	2	9.5
13	SM D	EXP	7
14	SM 1	FM #2-2	12/30.5
15	SM 2	SEN-1	9.5/24.2
16	SM 3	SSP-1	17/43.2
17	SM 4	FM #2-1	9/22.9
18	PUR #2-2	SSP-2	18/45.7
19	SCL-2	SCL-3	9.5/24.2
20	SCL-5	EXP	11/27.9

Explanation of above abbreviations:

MM	Main Manifold
SM	Sample Manifold
RP	Survey Probe
SCL	Calibration Leak Assembly
FM #1	Flowmeter (Sample)
FM #2	Flowmeter (Sensor)
PUR #1	Purifier (Zero Gas)
PUR #2	Purifier (DYNA-LOOP)
SSP	Short Stroke Pump
LSP	Long Stroke Pump
SEN-1	Sensor (Filter)
SEN-2	Sensor (Socket)
EXP	Exhaust Port


EXHAUST PORT
RELIEF VALVE
INTERNAL
T20
5
BYPASS
T18
V3
SURVEY PROBE CONNECTOR
ZERO GAS FLOW ADJUST
SAMPLE FLOWMETER
PURIFIER NO. 1
T10
T9
T8
T7
T6
T5
T4
T3
T2
10
9
8
7
6
5
4
3
2
SAMPLE LINE CONNECTOR
V2
V1
ZERO GAS
SAMPLE

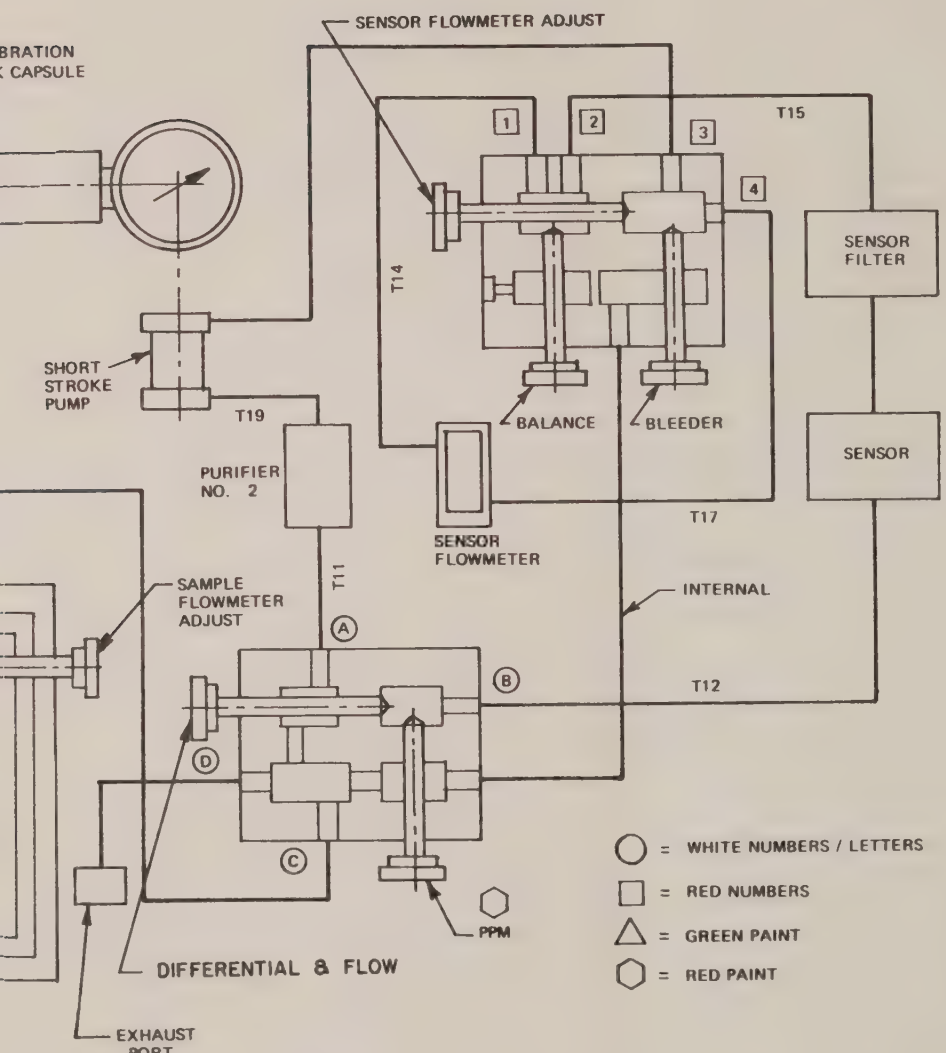


Figure 8-8. Tubing Diagram

8.2.4 Pump Replacement

1. Remove valve assembly (1, Figure 8-5) per paragraph 8.2.9.
2. Remove three screws which secure shroud to fan motor assembly (25) and remove shroud.
3. Remove tubing from upper and lower pump nozzles (bottom is exhaust).
4. Disconnect bayonet-type clip leads from each side of motor.
5. Remove four screws and nuts which hold pump and motor assembly to bottom of chassis.
6. Connect motor leads to replacement pump.
7. Mount pump on chassis with four screws and nuts applying Loctite (GE A15B41E) to threads of screws before installing nuts.

   CAUTION: DO NOT OVERTIGHTEN PUMP MOUNTING HARDWARE. LEAVE SPACE BETWEEN GROMMET AND SCREW FOR VIBRATION ISOLATION.

8.2.5 Speaker Replacement

1. Remove two screws (16, Figure 8-5) and remove rod (8).
2. Remove four screws holding speaker to rear of chassis.
3. Disconnect two bayonet-type clip leads attached to speaker terminals.
4. Install new speaker, keeping speaker terminals near pump assembly when mounting speaker on rear of chassis.
5. Apply Loctite (GE A15B41E) to threads of two lower speaker mounting screws before installing them.
6. Install rod (8) and secure with screws (16).

8.2.6 Alarm and Logic Printed Circuit Board Replacement

1. Loosen nut (18, Figure 8-5) and back out screw (20) which contacts upper rear corner of printed circuit board (21).
2. Loosen screw which secures printed circuit board connector to chassis.
3. Remove four knobs from printed circuit board potentiometers.
4. Press clip (17) and move rear of printed circuit board to right (when facing front of monitor) until it clears chassis, then move printed circuit board to rear until four potentiometer shafts are clear of chassis front panel.

5. Hold printed circuit board connector and disconnect printed circuit board.

6. Install new printed circuit board making sure that it is completely engaged in its connector.

8.2.7 Amplifier Printed Circuit Board Replacement

1. Loosen nut (14, Figure 8-5) and back out screw (15) which contacts upper rear corner of printed circuit board (7).

2. Loosen screw which secures printed circuit board connector to chassis.

3. Remove two knobs from printed circuit board potentiometers.

4. Press clip (13) and move rear of printed circuit board to left (when facing front of monitor) until it clears chassis, then move it to rear until both potentiometer shafts and toggle switch are clear of chassis front panel.

5. Hold printed circuit board connector and disconnect printed circuit board.

6. Install new printed circuit board making sure that it is completely engaged in its connector.

8.2.8 Power Supply and Sensor Printed Circuit Board Replacement

1. Loosen screws which secure printed circuit board (22, Figure 8-5) to chassis.

2. Remove knob from printed circuit board potentiometer.

3. Disconnect hose from filter (23).

4. Remove screw that attaches heat sink bracket (part of printed circuit board assembly) to front of chassis.

5. Move printed circuit board as far to rear as it will go, then lift board straight up and out of its connector.

6. Disconnect hose on bottom of socket assembly.

7. Reconnect hose to bottom of socket assembly of new board.

8. Install new printed circuit board applying Loctite (GE A15B41E) to threads of screw that secures heat sink bracket.

9. Make sure printed circuit board is completely engaged in its connector.

8.2.9 Valve Assembly Replacement

1. Remove screw and detach sample manifold assembly (1, Figure 8-5) from valve assembly (2).

2. Remove coupler (3) from rear of valve assembly.

3. Disconnect six bayonet-type clip leads attached to valve assembly terminals, noting wire connection points and colors.

   NOTE: CHECK THAT TUBE MARKERS ARE IN PLACE BEFORE DISCONNECTING TUBES FROM VALVE ASSEMBLY.

4. Remove tubing from valve assembly connections.

5. Remove screw and washer that secure valve assembly to rear of chassis.

6. Install new valve assembly applying Loctite (GE A15B41E) to threads of screws.

7. Connect each tube to like-numbered port on valve assembly (see Figure 8-8).

8. Connect wires to appropriate terminals.

8.2.10 Calibration Leak Capsule Replacement

Maintenance is not required on the calibration leak capsule (Figure 3-3); however, the capillary may become plugged if excessive moisture or dirt are allowed to come in contact with the end of the leak, or if the internal pressure in the capsule is allowed to go below atmospheric pressure. If the capillary becomes plugged with dirt, it must be replaced. Moisture may be removed by baking the pyrex capillary at 480°F (250°C) for about two hours, preferably in a vacuum.

To disassemble the calibration leak capsule;

1. Remove capillary retainer, using wrench from kit 4777K44G704 supplied with capsule.

2. Remove capillary assembly, O-rings, and spacer.

To assemble the calibration leak capsule:

1. Place O-rings and spacer on capillary in following order from small end and install in metal shell (O-rings should be free from dirt and not lubricated when installing glass capillary):

   (a) plastic washer

   (b) single O-ring

   (c) metal spacer

   (d) double O-ring

2. Install capillary retainer, using wrench from kit, tighten snugly.

NOTE: AFTER ASSEMBLING, THE CAPILLARY SHOULD BE PROTRUDING 0.700 INCH (1.778 CM) FROM THE SHOULDER OF THE UNIT. THIS ALLOWS PROPER POSITIONING OF THE METAL BAND ON THE LEAK CAPILLARY AND AVOIDS LEAKAGE UNDER AN O-RING.

If gas is being lost at a greater leak rate than specified, check the gage seal and the O-rings on the capillary assembly. If they are leaking, replace them. After removing either the leak capillary or the gage, purge with gas for approximately one minute using the tube assembly, then replace gage or leak capillary as quickly as possible. This insures that pure dry gas is in the capsule as required for proper operation.

SECTION IX

REPLACEABLE PARTS

This parts list describes user replaceable parts for the Toxic Vapor Monitor (see Figure 9-1). It is not to be taken as the authority for the procedure of assembly or disassembly of the equipment. It is intended for use in requisitioning and identifying parts.

Replacement parts that are listed in Table 9-1 may be ordered through the factory Renewal Parts unit. For price and delivery information, contact Product Service, Area Code (617)594-7237. It is requested that the following information be provided to expedite handling of parts orders.

1. Part description, General Electric catalog number or part number, and quantity.

2. Model and, if applicable, serial number and rating of component for which part has been ordered.

3. General Electric publication number and reference used in identifying part.

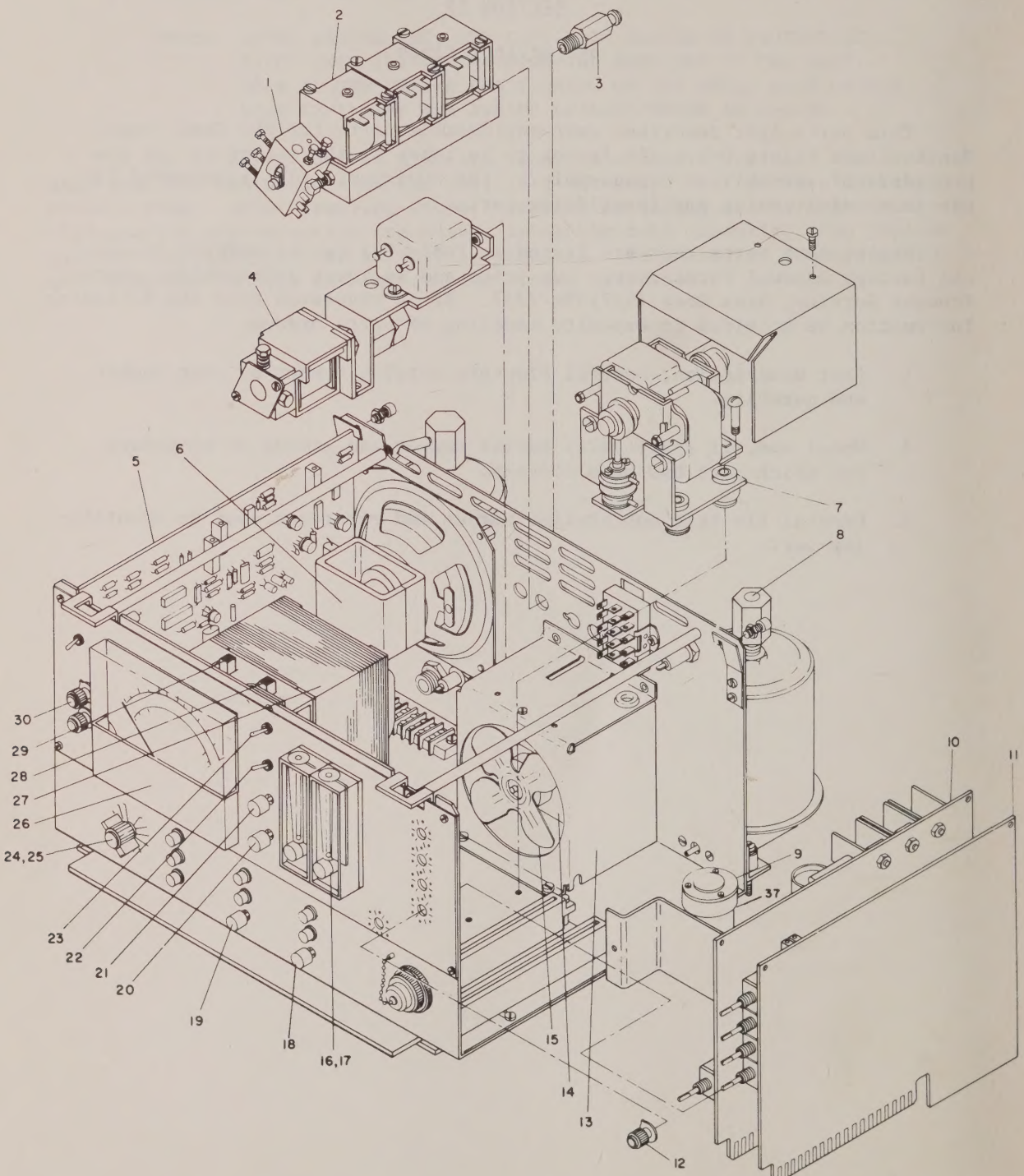


Figure 9-1. Replaceable Parts

Table 9-1. Replaceable Parts

Figure 9-1 Index No.	Part No.	Description
1	5485644-60G1	Sample manifold
2	5485644-58G1	Valve assembly
3	2792K64P001	Coupler quick connect
4	5485644-59G1	Calibrating leak assembly
5	1623K24G1	Amplifier printed circuit board
6	5485644-131G1	Speaker assembly
7	5485644-57G1	Pump and motor assembly
8	3564K51-001	Check valve filter
9	*5485644-116G1	Sensor filter assembly
-	*5485644-86-001	Screen
-	*5485644-85-001	Filter
-	*5485644-95-001	Gasket
10	1623K25G1	Power supply and sensor printed circuit board
11	1623K26G1	Logic and alarm printed circuit board
12	4793K15G3	Right hand knob assembly
13	5485644-73G1	Fan motor assembly
14	5343K94-006	Fan motor
15	3502K41-002	Fan
16	5485644-114G1	Flowmeter fitting assembly
-	6311K12-026	O-ring
-	5485644-23-001	Disc
17	5224K10G3	Flowmeter
18	5485644-9-7	MANUAL CALIBRATE pushbutton switch
19	5485644-9-7	MANUAL SAMPLE pushbutton switch
20	5485644-9-8	EMISSION pushbutton switch
21	5485644-9-7	AUTO GAIN pushbutton switch
22	5485644-9-11	INT REF/EXT REF/ZERO GAS toggle switch
23	5485644-9-10	MAN/AUTO toggle switch
24	5485644-117	RANGE switch
25	4789K33-001	Range switch knob
26	5485644-100-52	PPM panel meter
27	5485644-56G1	Transformer assembly
28	5485644-100-29-3	117/234 VOLT slide switch
29	5485644-100-29-2	50/60 HZ slide switch
30	4793K15G2	Left hand knob assembly
-	5485644-100-100	Teflon tape
-	5485644-100-97	Shrink tubing - 200 feet
31	*5485644-100-37	Lamp (amber)
32	*5485644-100-75	Lamp (red)
33	*2027K41-001	Air purifier
34	*5485644-100-78	Fuse 3/8 amp (remote)
35	*5485644-100-59	Fuse 1.5 amp (line)
36	5485644-40-1	Fan filter
37	*6614K11G1	Sensor
-	*5485644-125-001	Sample line filter (external)
-	*3664K51-108	Sample line filter (internal)

*Maintenance parts.

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